Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, APRIL 4, 1908. No. 14.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
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239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....590 Old Colony Building
CLEVELAND OFFICE.....1015 Schofield Building
PHILADELPHIA OFFICE.....Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico.....per year, $3.00
Dominion of Canada.....4.50
Other Foreign Countries within the Postal Union.....6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 23,000 copies are printed.*

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THE BRIGHTER OUTLOOK.

One of the revival hymns of the last generation contained two lines to the effect that "Skies are clearing, and we're hearing joy-bells everywhere." This might easily be applied to the present industrial and financial situation in the United States, but it is well to take a quiet and sober view of the various unmistakable signs of recovery from the panic of the autumn and the distress of the winter. Even now, there are losses as well as gains, and many fields of production are still suffering from restricted output and an inadequate demand. But at such times as this, it is the state of mind and the tendency that really count, and here we find full warrant for hopefulness, and for a tempered optimism.

We note among the electrical companies several bright symptoms. The General Electric and Westinghouse interests report good orders, and a fuller tide of activity in their shops. Large contracts for traction cars are being given out, and others impend. The New York Edison Company reports that its February business was equal to that of the same month in 1907. The Bell telephone system is resuming construction work that will run to $50,000,000 this year, and last week 49 new Independent telephone companies reported, 26 of which had a capitalization of $720,000. The purchases of copper on electrical account are growing again, and resumption of transmission enterprises is noticeable. It is apparent that the general tone is very much improved in the electrical field, and that there are good reasons for an increase of cheerfulness.

Outside of the electrical field, the symptoms are mainly of an encouraging character. President Gary, of the U. S. Steel Corporation, has reported orders to be increasing at a rate of even 25 per cent gain over the preceding month. Railroad earnings are better in several systems, and the number of idle cars is still dwindling. The building trade is more active, and the mildness of the opening of spring has greatly stimulated retail trade. In New York, bank and trust company resumption has had a markedly good effect, and the barometrical indications from Wall Street are all those of a rising glass. There is nothing in national political actions to arouse anxiety, but, on the contrary, there is a distinct betterment in the public and legislative attitude on corporations and railway affairs. Hence we do not think it is amiss to suggest to our friends that the day for pessimistic doubt and inertia is behind them and not ahead. All the situation now requires is a little courage and some confidence in the shape of renewed vigor in attacking opportunity and in creating new capital.

It is fortunate that two recent decisions in the United States Supreme Court should have come at this time to show that the railroads have a resort from which to obtain relief from both fines that are too large and fares that are too low. Their property rights under the Constitution are to be respected, and

the Minnesota and North Carolina decisions emphasize this in a manner cheering to all who are desirous of seeing the railroads regulated, but not willing that they should be made the subject of confiscatory laws. Another point helpful at this time in general betterment is the readiness of the corporations to let investors know where they stand. The issuance of monthly net earnings statements by the New York Central and the appearance of the first American Sugar Refining report are both evidences that the demand for fuller publicity is to be met voluntarily, and that legislation to this end is along the right line. It is in this manner again that solid foundation is being laid for the new prosperity of the near future.

Power in the Appalachians.

A recent circular of the U. S. Department of Agriculture (No. 144) gives a large amount of interesting and valuable information regarding the water powers of the Southern Appalachian region and the steps necessary to their conservation. In some measure this is involved with the question of forestry and the proposed reserves about the headwaters of the Appalachian streams. As we have heretofore intimated, the amount of precise information about the effect of deforestation on water power is very meager owing to the short length of time covered by the investigations. In those regions of the country in which water powers have been longest under measurement, partial deforestation had occurred prior to such measurement, the first growth having been cleared away and the land converted to farming and grazing for many years. For instance, in the case of the Merrimac, or any other of the well-developed New England streams, the amount of woodland on the watershed has not changed greatly in half a century save for the devastation wrought about the headwaters in the last decade or so. The country had been well cleared early in the last century as regards the lower portions of the watersheds. Hence, while there is clear evidence of a tendency to lower minima, this evidence cannot be made useful as regards the amount of damage for some years to come.

The nature of such damage is clear when one considers the state of flow in the rivers of a really denuded country like some parts of the West. The ultimate amount of damage depends in part on the geological formation and the nature of the soil, but in the judgment of the forestry experts, the danger in the Southern Appalachians is especially great. That region is practically devoid of natural lakes, which in New England are of great value in steadying the flow; and one of the most interesting and valuable portions of the report before us relates to the possibilities of artificial storage. A lake is a far more useful conservator of water power than any amount of forest, since it is under complete control, and the rate of run-off into it becomes a matter of no consequence provided the total amount is well maintained. The chief thing is to secure storage capacity enough to make full use of the total rainfall, and the main difficulty is to get so complete and immediate control of the upper watersheds as to make their utilization possible. In our country as at present constituted it is wellnigh impossible to hold any man's attention to a project that looks to the future—he is ready only for a chance to grab profits and run. The general government is really our only hope in a case like this, for the States have generally proved their impotence in large affairs of a nature bound to bring protests from local looters. Now and then a State rises to the occasion, but in large affairs, where prompt and effective co-operation in several States is necessary, present experience is discouraging; and when it comes to national action there is a not unnatural jealousy of centralized power that makes action exceedingly difficult to secure. To tell the truth, the situation is not exactly encouraging.

If, however, such action were possible the results to be obtained are of a most important character. Discounting as one must the figures of the report on account of the low gradient which holds over much of the stream-slopes, there still remains a prodigious amount of water power that can economically be utilized. The figures before us indicate a total based on low water conditions of something like 1,500,000 effective horse-power. This amount can be easily doubled by the use of a moderate amount of auxiliary steam power. The amount to be obtained with fairly complete storage is, of course, very indefinite as yet, but perhaps a total of 10,000,000 horse-power would not be wide of the mark. The trouble is that this prodigious gain can be secured only by very drastic action, which would amount practically to governmental control of the hydraulic resources. No form of State or private control is adequate unless more than equally dangerous. The time has come in the world's history when people cannot safely trust to the casual and thoughtless development of national resources. Up to a certain point these are not extensive enough to work evil, but to-day the wholesale waste that goes on in many directions is a public menace against which the most elementary principles of self-preservation call for action. In the case before us, the industrial possibilities of seven or eight million horse-power available through large storage works are tremendous, especially in view of the depletion of the cheap coal supply. The concrete problem is, granting the great desirability of the result, whether it can by any now practicable means be accomplished. The larger project certainly looks dubious in view of the general trend of present public sentiment; but there certainly is no reason why the first reserve proposition could not be carried out, thereby holding at least part of the necessary territory and protecting the natural watersheds until such time as more effective action with respect to storage could be secured.

British Standard Specifications for Consumers' Supply Meters.

It is only a few months since the Engineering Standards committee in London issued a schedule of standard specifications for customers' meters. This schedule possesses interest for all central station men, as indicating the relative conditions of service, installation, testing and maintenance among the English-speaking electric supply systems on the two sides of the Atlantic Ocean. In regard to standard meter capacities, the schedule only recognizes seven, namely, for 3, 5, 10, 25, 50, 75 and 100 amperes. The standard pressure of supply for these meters is not stated, but is probably 200 volts, adapted to 400-volt 3-wire systems. In America, there are 15 standard ampere-capacities of meters, between 3 and 100 amperes inclusive, and each is constructed in four different types, namely,

for 2-wire 110-volts, 2-wire 220-volts, 3-wire 220-volts and 2-wire 500-volts. The schedule calls for at least two sealing places on the case, one for the manufacturer and the other for a testing authority. In addition to this, the cover of the terminal compartment has to be provided with a sealing place for the purchaser—that is, the central station. In America there is usually only one seal on a meter. The name-plate is required to indicate, in addition to the usual electric data, either the speed of the rotor at full load, or the number of rotor revolutions for registering one kw-hour. It is specified that the full-load rotor speed shall not exceed 150 r.p.m. The waste of power in the main circuit path through the meter is not to exceed 15 watts at rated load, and the drop of pressure in this path must not exceed 2 volts at rated load. This would represent 1 per cent drop, a somewhat generous limit. The waste of power in the pressure circuit is specified not to exceed 4 watts for each 100 volts of pressure. This is consistent with good American practice in commutator meters. In meters of the induction type, which take less excitation, our potential losses per hectovolt are usually from 2 to 3 watts. The schedule requires that, in meters of 10 or more amperes capacity, the starting current shall not be more than 1 per cent of the rated load current applied during a steady test of five minutes. In other words, a meter must start and run steadily during a five-minute test, with 1 per cent of its rated load, under normal terminal voltage.

The error of a meter when tested under standard conditions of voltage, current, frequency and temperature is required not to exceed 2½ per cent between rated load and one-tenth of rated load. At any load between one-tenth and one-twentieth of rated load, say 1/N of rated load, the percentage error is not to exceed N/4. This is not a severe requirement on non-inductive loads when meters are new; but it is somewhat severe on meters which have been in extended service without readjustment. The overload requirements of a meter are that it shall not be injured by 25 per cent overload current at normal pressure for one hour, but that no greater margin of protracted overload than this should be called for. Also, that the meter shall not be injured by 15 per cent overload pressure for one hour. Moreover, the meter should stand, for not more than half a second, the application of 30 times rated load current, under rated voltage, without injury or impairment of calibration. This amounts to a definite short-circuit test applied through a circuit-breaker. In regard to underload tests, the meter must not creep with no current in the main circuit path when the voltage on the potential circuit is 10 per cent above rated voltage. In regard to variations of condition, alternating-current meters must not exceed 1 per cent of error due to change in frequency, when the frequency varies 5 per cent above or below its normal rated value. Meters with potential circuits must not exceed 1 per cent of error due to change in potential, when the potential varies 10 per cent above or below its normal rated value. Alternating-current meters must not exceed 2 per cent in error due to change in power-factor, when the power-factor of the load is varied from 100 per cent to 50 per cent. The last requirement is rather severe.

The manufacturer of the meter is made responsible for defects either in material or in workmanship that may become apparent within three years after the date of delivery. Moreover, if the meter is found to be registering with an error in excess of the limits specified, and shall not have been subjected to unreasonable usage, the manufacturer is made responsible for the readjustment of the meter at his own expense. It would be interesting to learn how far this schedule is actually applied in Great Britain, and how it works out. It would seem that there is a broad opportunity for disputes between the manufacturer and the electric supply company or purchaser, on the question of what constitutes unreasonable usage or as to defective material. In England, a number of manufacturers supply meters and it is perhaps a matter of practical necessity to specify rigidly the requirements of meters from the standpoints of the consumer and of the central-station operator. In the United States, the manufacture of meters is limited by patent considerations to a few firms, so that rigid specifications of the manufacturer's liabilities are not so important.

The Use of High Voltages.

Recent steps indicate that there is likely soon to be a material increase in the voltages used for power transmission. Practice hung for a long time in the neighborhood of 50,000 volts, but now 70,000 have been successfully passed and considerably higher pressures are in sight. True, most of the ordinary cases of power transmission do not require higher pressures than are now commonly used, but as time goes on the scope of the transmission problem widens. A considerable number of important powers all the world over are at so great distance from profitable markets that they require extreme voltage for successful utilization. Besides, there are groups of lesser powers which could be very advantageously joined into great transmission networks if voltages were available to keep down the cost of conductors. For the former class of powers the working pressure should be at least 100,000 volts, and preferably double that figure in many cases. For the latter class 100,000 volts would often be desirable. Now, as we have many times remarked, the problem of high-voltage transmission is essentially one of line insulation. Transformers can now be built, and in large capacities at a reasonable cost, for pressures much greater than anyone has cared to adopt for a commercial line.

So far as insulators are concerned, the trouble comes not from inability to get a suitable quality of porcelain, but from the extreme precautions required to prevent arcing under severe weather conditions. Up to 60,000 or 70,000 volts the insulators are quite manageable, but when one talks about 100,000 or 150,000 volts, with any reasonable factor of safety, the situation changes. The suspension types of insulator are as yet untried on any considerable scale. They are of considerable promise, yet it is not clear that they meet sufficiently well the requirement of preserving adequate dry surface in a drizzling rain. The modern insulators with deep petticoats stand up well under the wet test, but whether it will be practicable to secure mechanically good suspension insulators with equally good protection is quite another matter. If all the surfaces are wet, increase in their number or dimensions is not very efficacious. On account of the importance of lessening the number of insulation points very high-tension lines will necessarily be of long-span construction, with towers giving proper support for

probably rather elaborate insulating structures. In fact, the available length of span will be a very important consideration in the design of such lines. This necessity may lend a new interest to composite cables and wires to gain the utmost tensile strength, and especially the highest practicable elastic limit. It is this latter that especially counts in line design.

Incidentally, in such long-span work the towers will have to be designed as engineering structures, not merely put together anyhow. Another feature of design which must be carefully studied is the stability and strength required to withstand wind and ice stresses. We are under the impression that engineers are generally more scared than hurt on this account. The lines which go down in storms are very rarely power transmission lines, but telephone and telegraph lines, with from a dozen to fifty rusty wires carried on each venerable pole. In laying out a long-span line, study should be made of the actual meteorological conditions in the region where it is to be erected, and the line figured accordingly. One does not have ice storms in the South, nor are actual wind pressures at all as high as they are commonly taken in line calculations. With the points of support reduced to the minimum number, leaving a reasonable factor of safety, the insulators can be made adequate without extraordinary expense. One can use insulators in tandem without difficulty in a tower construction with plenty of vertical space, and it should be entirely feasible with material even now available to go at least to 100,000 volts while retaining at least as good factors of safety as are now common at 50,000 or 60,000 volts. Before going higher these factors of safety should be considerably stiffened. A factor of 3 is none too high for reasonable security. It seems not unlikely that the suspension type of insulator can be developed for proper protection against rain, and with this available there seems no reason why 150,000 volts should not be tackled in the near future. He would be a rash prophet who would venture to set an upper limit for the future, but with a working voltage of 150,000, most if not all of the big transmission projects could be worked out commercially. The remainder could well await the next upward step.

The Commercial Importance of Meter Accuracy.

Some station managers do not realize the importance of accuracy in the registration of customers' meters, and are content, provided that the meters do not creep, or make false registration under no load, even if the average registration is several per cent low. Nevertheless, 1 per cent of average defective-meter registration means not only 1 per cent less revenue, but would offset several per cent of economy in fuel or other operating expenses. A meter which failed to record the supply to one last lamp in an installation, the last 50-watt lamp that might burn alone for 20 hours in 24, would lose one kilowatt-hour a day, or a revenue in one year of $36.50, at 10 cents per kilowatt-hour. It is not only well worth while paying a good fair price for accuracy in the first cost of a meter, but it is also well worth while employing skilled and well-paid labor for meter inspection and attendance. A good meter inspector will amply justify his expense to the central station and no man is qualified to read and inspect meters who is not capable of testing, adjusting and repairing them. Some managers think that anyone can read a meter dial. It is true that very little training is needed for reading the figures on a meter-dial and writing them down correctly in a book, but meter inspection includes an examination into the condition of meters and a test of their registration at intervals of from one month for the most important meters to 12 months for the least important meters. It has not yet been realized, because the conditions have not yet had time to reveal themselves, that the advent of the new metallic-filament lamp in general, and of the tungsten-filament lamp in particular, will throw greater demands upon the meters and meter department of electric lighting systems. The smaller the power consumed by each individual lamp, the greater must be the precision in meter registration in order to attain the same ratio between kilowatt-hours sold and kilowatt-hours generated. It is true that the first effect of the change in lamps will be to increase the light per lamp turned on, rather than to diminish the power consumed per lamp, but sooner or later we must expect that the economy inherent in the use of the new filaments will develop in both directions.

Combination Gas and Steam Engine Plants.

The gas engine and the crude oil engine are finding an increasing use among small central stations. However, in spite of the recognized economy of these engines in fuel costs per kw-hour, their introduction has not been as rapid as some of their advocates predicted some 10 or 15 years ago. It is now well established that, except where coal is very cheap, a small engine operating on producer gas or an efficient crude oil engine can produce a kw-hour at much lower fuel cost than the ordinary small steam plant. Where cheap natural gas is available, there is no question about the economy of the gas engine. It may, therefore, seem rather remarkable that gas engines are not to be found in a larger number of small central stations. In looking for the causes of their slow introduction, one naturally inquires first as to the reliability and maintenance cost of the gas engine. As to this, the gas engine seems to have about as good a record as the steam engine in plants where it has been in service the past five years. An answer to the question is then hardly to be found in the unreliability of the gas engine in its smaller sizes. The fact that gas engines are not as well understood as steam engines has undoubtedly had an effect on their adoption. When we come to the question of first cost, the gas engine plant is so much more expensive than the average small steam plant that this furnishes a powerful reason for its slow introduction. In some small central stations the owners are averse to spending a cent more than is necessary in apparatus to give increased capacity. In some cases this aversion is fully justified. It can be laid down as a general proposition that for carrying purely peak load, low first cost and reliability are first considerations and fuel cost per kw-hour secondary, for the reason that the fixed charges on the investment far outweigh any possible difference in operating economy for the few hours the peak-load machinery is operated. For such machinery as operates 24 hours per day, the case is entirely different. It has been suggested, and in fact put in practice by a number of companies, to combine steam and gas engines in one plant, using the gas engines with high-fuel economy for carrying the all-day load and using steam engines and boilers for the peak load only. The large fixed losses which occur when

operating a steam plant greatly underloaded 24 hours a day are thus obviated, and the investment is much lower than it would be to carry the entire peak load with gas engines. The objection to this plan is, of course, that it necessitates two different kinds of engines in the same plant, and perhaps not a very large plant at that. Uniformity of apparatus, which is in general desirable, is thus not obtained. These reasons may, however, be largely sentimental, and it should be carefully figured out in every case which method will give the lowest total operating expenses.

Diffusing Light from High Candle-Power Lamps.

The increasing use of lamps of very high intrinsic brilliancy and high candle-power for interior lighting, and the increasing consideration that is being given to the comfort of those who occupy rooms so lighted, makes the desirability for diffusing the light from these high candle-power sources a matter of serious consideration. This problem has always been before those engaged in illuminating work, but it is being more clearly recognized as an important problem now than ever before. It will be generally admitted that for eye comfort during continued work, nothing in the way of artificial lighting can equal daylight as it is ordinarily received through windows. In the case of daylight, the light in a room is received by reflection from the sky and clouds. It is, therefore, so well diffused that no definite sources of light are recognized, as is the case with artificial illuminants. In artificial lighting, on the other hand, we depend upon more or less concentrated sources of light. This at once gives rise to two difficulties. The first, and most important of these, is that in writing with the highly glazed papers now common, or in working on polished metal surfaces which are fairly good reflectors, there is a considerable amount of regular reflection from the surface under the eye. This glare or glisten of regular reflection is so pronounced that when the eye is in some positions it makes reading impossible, as nothing but the glare can be seen on the paper, while in many other positions it is annoying. This may seem like a rather fine-spun theoretical point, but, as a matter of fact, it is the unrecognized source of a great deal of the trouble which is experienced in working by artificial light.

To be sure, this trouble can to a large extent be overcome by proper placing of the lamps, so that the regular reflection does not strike in the eye; but this is not by any means as easy as it sounds. For example, with any form of desk lamp placed anywhere in front of the worker, he will many times an hour be annoyed (very likely without knowing it) by this glare. It is much more pronounced with the common arrangement of a desk lamp squarely in front than it is when the lamp is placed either to the right or the left; but practically the only position in which a desk lamp can be placed so that the worker will never be annoyed by reflection from the paper and at the same time will not have annoying shadows, is at the left and slightly behind the worker. Now this is a position which is in a great many cases impractical. In fact, about the only place where it is feasible is where the lamp can be placed high on a chandelier or pendant at the position spoken of, unless the worker is willing to put a portable stand lamp at his left elbow. Now much of the trouble which is constantly experienced with artificial light could be considerably reduced if we could employ larger light-giving surfaces instead of the intense light sources of small area we now use. In the lighting of stores and public places the difficulties which have just been enumerated, due to reflection from the surfaces being worked upon, is not so serious as in offices, factories and homes; but it is equally objectionable for another reason, namely, the bad effect the intense light sources themselves have on the eye. In the lighting of stores and public places the eye cannot avoid the light sources by shading of the lamps or by the shading of the eyes by the eyebrows. It is, therefore, also desirable in these places to greatly increase the area of the visible sources of light.

The common method of increasing the visible light-giving surface of a lamp is, of course, to use small globes of frosted, opal or prismatic diffusing glass, or to resort to frosted lamps. This improves matters considerably, but leaves much to be desired, especially with the higher candle-power incandescent lamps now common. The inverted bowl shape of reflector, which is justly becoming more popular day by day, besides giving a very efficient light distribution at all angles below 70 degrees from the vertical, also covers the lamp in a way to reduce considerably the intrinsic brilliancy meeting the eye if a lamp with frosted tip bulb is used. It is, however, desirable to increase the area of light-giving surface even further than this. The use of very large enclosing globes of diffusing glass with the lamp and the proper reflector mounted inside the globe increases the expense of each lighting unit considerably, but also makes for decidedly better results by a great increase in the area and decrease of intensity of the light-giving surface. Another plan which is just beginning to gain foothold is the use of recesses and false skylights, behind which lamps are concealed, the skylight consisting of diffusing glass. When properly designed so that the light sources spread their illumination evenly over the skylight, this plan gives results which begin to approach daylight in effect. Undoubtedly the nearest approach to daylight diffusion can be obtained, however, with properly designed indirect lighting. The qualification, "properly designed," is important, because it has been very thoroughly demonstrated that some indirect lighting schemes are both inefficient and trying to the eyes. If indirect lighting from concealed lamps is to be successfully accomplished, it must be by means of reflecting surfaces of proper shape to direct the light down where it is needed without excessive loss through a number of reflections. These reflecting surfaces must also be in such a position as to be easily avoidable by the eye of the ordinary occupant of the room. For example, if the indirect lighting scheme is such that there is a large amount of highly illuminated sidewall, which the eye cannot very well avoid, it has been well demonstrated that the eye demands a higher illumination on a reading page for comfortable reading than if this brightly lighted surface were not present. In other words, a large, brightly lighted surface of this kind is almost as effective in causing the iris to automatically close and shut light out of the eye as would be a row of bare lamps in a similar position. The art of indirect lighting can well be cultivated more thoroughly, as can also the art of placing light sources behind diffusing glass screens without undue expense for fixtures and glassware and without undue loss of efficiency.

Annual Report of American Bell Telephone System.

The annual report of the American Telephone & Telegraph Company, signed by President T. N. Vail, presents a highly interesting and impressive aggregation of statistics relative to one part of the telephone industry in the United States. It is much fuller of data than usual, and discusses most of the vital problems of the existing situation with notable frankness and fulness.

At the close of the year a valuation based on the replacement cost of the existing plant, without any allowance for franchises or for unearned increment, showed $488,296,000. Against this there were outstanding obligations of the American Telephone & Telegraph Company and its associated companies, including capital stock at par in the hands of the public, of $554,939,000. These companies also had cash on hand, quick assets and investments of $101,074,000, so that the obligations against the plant were only $453,865,000, or $34,431,000 less than its appraised value The book value of the exchange construction is $114 per exchange station, and the book value of all the property, including the long-distance lines, is $162 per station. The American Company holds $273,404,797 in stocks and bonds of its associated or sub-companies, and has $41,621,174 in its long-distance plant. Its capital stock is $179,595,255, and its bonds and convertible notes amount to $178,495,000.

For the first time a statement of the operating companies (that is, those companies which directly furnish Bell telephone service) is given, with gross earnings for the whole country of $120,753,200, operating and general expenses of $53,242,300, and maintenance of plant $34,665,700. The balance available for dividends was $25,819,700, out of which dividends amounting to $19,206,100 were declared, which seems reasonable when the value of the plant is considered. The American dividends paid were $10,943,644.

At the present time there are outstanding 1,525,280 shares of stock of the company, 1,312,502 of which are held by 23,453 stockholders, an average of less than 56 shares each, the balance, 212,778 shares, being held by 16 shareholders, each with 5000 shares or over. Mr. Vail states that more than three-quarters of the entire share capital is still held in the New England States.

The business has shown a constant gain during the year, and at the close there were 3,839,000 stations connected to the system, with a total of 8,610,592 miles of wire. The total number of exchange and toll calls for the year was about 5,997,000,000. During the year $52,921,000 was added to construction, and in the past eight years $351,835,655 has been so added. Of the stations connected 755,316 belong to other systems than the Bell. There was a total gain during the year of 768,340 stations. The number of exchanges and branch offices is 5108, an increase of 219, with a total of 88,274 employees.

Mr. Vail directs attention to the new Western Electric policy of selling telephonic apparatus to all comers instead of to licensees exclusively. He favors placing telephone companies under public service commissions and argues strongly in favor of the "natural monopoly" one exchange idea. "Duplication of plant is a waste to the investor. Duplication of charges is a waste to the user. The advantages claimed for competition are lower rates and improved service. Exhaustive competition may temporarily produce either or both of these results, but, as before stated, this temporary gain is purchased by an excessive waste. Duplication of plant and operation cannot produce either result without exhaustive competition. Given the same management, the public must pay double rates for service, to meet double charges, on double capital, double operating expenses and double maintenance.

"In most cases of proposed competition an examination of the prospectus will show that, by the same process, it is expected to make good a capitalization equal to at least two or three times the actual cost of the construction. The only benefits are to the promoter."

Chicago Commonwealth Edison Ordinance Passed.

The ordinance fixing the maximum rates to be charged by the Commonwealth Edison Company, of Chicago, until 1912, was passed by the Chicago City Council March 23. The ordinance also recognizes the consolidations which led up to the Commonwealth Edison Company organization. The company is to pay 3 per cent of its gross receipts to the city. This is in accordance with the franchise previously owned by the Commonwealth Electric Company. The rates are as follows: Up to July 31, 1908, 15 cents per kw-hour as a primary rate for energy used up to the equivalent of 30 hours' use of the consumer's maximum demand, and 9 cents per kw-hour as a secondary rate for all energy in excess of the foregoing amount. After July 31, 1908, the maximum rate is to be 13 cents, and secondary 9 cents. From Aug. 1, 1909, to July 31, 1912, the primary rate is to be 13 cents and the secondary rate 7 cents. A discount of 1 cent per kw-hour from the foregoing rates is to be allowed on all bills paid within 10 days.

New British Patent Law.

Dr. Alfred Müller, of New York, has addressed to the Secretary of State, Washington, a letter making certain recommendations in relation to the revised British patent law which went into effect Jan. 1, 1908. A discussion of this law appeared in our issue dated Feb. 15.

Dr. Müller calls attention to that section which provides that at any time not less than four years after the date of a patent any person may apply to the Government for the revocation of the patent on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom. Should it be found after inquiry that the allegations are correct, then, unless the patentee proves that the patented article or process is manufactured or carried on to an adequate extent in the United Kingdom, or give satisfactory reasons why the article or process is not so manufactured or carried on, the patent may be revoked forthwith or after such interval as may be specified, unless, in the meantime, it is shown that the patented article or process is manufactured or carried on within the United Kingdom to an adequate extent. If within the time limited the patented article or process is not manufactured or carried on within the United Kingdom to an adequate extent, but the patentee gives satisfactory reasons why it is not so manufactured or carried on, the period above mentioned may be extended for such period not exceeding 12 months. Any decision under this section is subject to appeal to the court.

Dr. Müller asks that in view of the fact that the patent laws of the United States do not require British, or any other foreign inventors who have obtained patents in this country, to put their invention into practice in the United States, subject to the penalty of having their patents revoked for failure to comply with such a requirement, steps should be taken on the part of the government of the United States to induce the British Government to make the above section of the British law inapplicable as regards the United States of America, with the understanding that the putting into practice of an invention in the United States shall be equivalent to its execution in England.

Reference is made to a similar understanding recently arrived at between the government of this country and that of Switzerland, and it is stated that action similar to that suggested has already been taken on the part of Germany.

Dr. Muller informs us that in reply to his letter he has been informed that the State Department has set on foot negotiations looking to a conventional arrangement with Great Britain by which the lapse of a patent for non-working may be reciprocally waived. The American ambassador in London has reported that he has brought the subject to the attention of the British Government.

Lower Telephone Toll Rates Recommended in the Boston District.

In connection with the investigation of the telephone rates in Boston and suburban districts, and following out the lines of the report of Prof. D. C. Jackson, recently summarized in these columns, the Massachusetts Highway Commission has made recommendations as follows:

Provided, that the Legislature appropriates the money needed for the work, an inventory of the property of the New England Telephone & Telegraph Company shall be made as soon as possible, said appraisal to include the property of the company in Massachusetts in detail, and to extend over the remainder of the territory covered by the company's operations in accordance with a plan to be stated by the commission.

2. That careful studies of the traffic over the company's lines be made by the company during the period when the inventory and appraisal is in progress, following a plan to be submitted by the commission to the company at an early date.

3. That a preliminary adjustment of the toll rates now in force in the Boston and Suburban Division be made by a reduction in said rates between subscribers' telephones in all exchanges within a radius of five miles from the center of gravity of the metropolitan telephone service from 10 cents to 5 cents for each conversation of five minutes' length; it being understood that the following 16 suburban exchanges will be affected thereby: Charlestown, East Boston, South Boston, Cambridge, Chelsea, Roxbury, Somerville, Brookline, Everett, Dorchester, Revere, Winthrop, Jamaica Plain, Brighton, Malden and Medford exchanges.

Revision of the Electrical Code.

The sixteenth annual meeting of the Underwriters' National Electric Association was held in New York City, March 25 and 26. The reports of the various committees appointed last year were brought before the general meeting for final action and the numerous suggestions for changes in the rules received during the year were also given consideration. The changes and reports as finally approved will appear in the October "List of Electrical Fittings."

New rules were adopted governing the construction and installation of Cooper Hewitt lamps and Moore electric light tubes. The former must have a cut-out for each lamp or series of lamps, except when contained in a single frame and lighted by a single operation, in which case not more than five lamps shall be dependent on a single cut-out. The resistances or regulators must be enclosed in non-combustible cases, and where the resistances or regulators are subject to flyings of lint or combustible material, all openings through the casings must be protected by a fine wire gauze. Moore tubes must be installed so as to be free from liability to mechanical injury or of contact with inflammable material. The high-potential coils and regulating apparatus must be installed in an approved steel cabinet which shall be ventilated in such a manner as to prevent the escape of flame or sparks in case of burn-out. The apparatus in this box must be mounted on slate, and the enclosing case positively grounded. The supply conductors must comply with the rules governing low-potential systems where such wires do not carry current having a potential of over 300 volts.

The fine print note under rule 8, section *d*, was amended so as to make this apply to auto-starters only, and a new section was added to rule 60 governing the details of rheostat construction. New rules were approved governing the installation of transformers under low-potential systems, as follows: Oil transformers must not be placed inside of any building except central stations and substations, unless by special permission of the inspection department having jurisdiction. Air-cooled transformers must not be placed inside of any building excepting central stations and substations, unless the highest voltage of either primary or secondary does not exceed 550 volts, and must be so mounted that the case shall be at a distance of 1 ft. from combustible material or separated therefrom by non-combustible, non-absorptive insulating material, such as slate or marble. Where transformers are placed at a lesser distance, a slab of slate or marble somewhat larger than the transformer must be used, and where the transformer is mounted on a side wall, the slate or marble must be secured independent of the transformer supports, the transformer being supported by bolts countersunk at least ⅛ in. below the surface of the back of the slab and filled.

The committee on wiring of electric cranes reported the following rules, which were adopted:

All wires except bare collector wires, those between resistances and contact plates of rheostats and those subjected to severe external heat, must be approved, rubber-covered and not smaller in size than No. 12 B. & S. Wires between resistances and contact plates of rheostats must conform to No. 4-*c*, unless the wires are exposed to moisture, in which case the insulation must also be rubber. Wires subjected to severe external heat must have approved slow-burning insulation. All wires excepting collector wires and those run in metal conduit or armored cable must be supported by knobs or cleats which separate them at least 1 in. from the surface wired over, but in dry places where space is limited and the distance between wires as required by Rule 24-*h* cannot be obtained, each wire must be separately encased in approved flexible tubing securely fastened in place. Collector wires must be supported by approved insulators so mounted that even with the extreme movement permitted the wires will be separated at all times at least 1½ in. from the surface wired over. Collector wires must be held at the ends by approved strain insulators.

Where the wires are arranged in a horizontal plane above the crane, they must be supported at least every 20 ft. if practicable and separated at least 6 in., but if longer spans are necessary, the distance between wires must be increased proportionately, the span in no case to exceed 40 ft. If not arranged in a horizontal plane they must be carried along the runways and must be rigidly and securely attached to their insulating supports at least every 20 ft., and if not arranged in a vertical plane, must be separated at least 8 in.

Where bridge collector wires are over 80 ft. long, insulating supports on which the wires may loosely lie must be provided at least every 50 ft. Bridge collector wires must be kept at least 2½ in. apart, but a greater spacing should be used whenever it may be obtained. Collector wires must not be smaller in size than specified in the following table for the various spans:

Distance between rigid supports. Feet.	Size wire required. B. & S.
0 to 30	6
31 to 60	4
Over 60	2

Collectors must be so designed that sparking will be reduced to a minimum between them and collector wires. The main collector wires must be protected by a cut-out and the circuit controlled by a switch, cut-out and switch to be so located as to be easy of access from the floor. Cranes operated from cabs must have a cut-out and switch connected into the leads from the main collector wires and so located in the cab as to be readily accessible to the operator. Where there is more than one motor on a single crane, each motor lead must be protected by a cut-out located in the cab if there is one.

Controllers must be installed according to No. 4, except that if the crane is located outdoors the wires between resistances and contact plates of rheostats may be rubber-covered or bare or slow-burning if properly supported. If the crane operates over readily combustible material, the resistances must be placed in a fire-resisting enclosure, or if located in a cab, the cab must be constructed of non-combustible material and sides provided which enclose the cab from its floor to a height at least 6 in. above the top of the resistance.

The motor frames, the entire frame of the crane and the tracks must be permanently and effectively grounded.

A number of recommendations were made calling for con-

ductive coatings on cables, outlet boxes and fittings in order to secure better electrical contact at all points throughout systems in which they are used.

The committee on the recodification of the Code was continued. It is the purpose of the committee to separate the specifications for fittings, materials and details of construction from the Code and print these in a separate pamphlet. Cross references will be omitted where it is feasible, and the requirements themselves inserted. All fine print notes which are intended to be mandatory will be made rules, and those which are not mandatory will either be eliminated or else be printed as explanations. The committee also recommended that hereafter only reports of regularly appointed committees and definite suggestions for changes or additions be printed in the advance bulletins.

Slight changes were made in the rules governing the construction of circuit-breakers, panel boards and the marking of variable-speed motors. The committee on outline lighting presented a report quite different from that appearing in the advance bulletin, the latter not being the report of the committee, and the new report was adopted with slight amendments, as was also the report of the committee on street railways.

The report of the committee on outline lighting included general specifications of the class of construction required. Rubber-covered wire and moisture-proof receptacles are necessary and no circuit can contain more than 66 sockets nor carry more than 1320 watts.

The report of the committee of rule 13A, grounding of low-potential circuits, was referred back to the committee for further consideration. Since the publication of the report in the advance bulletin some of the interests in the conference have reconsidered their action so that much diversity of opinion existed as to what is a proper ground, what is the proper voltage at which to make the grounding mandatory, etc. On motion of Mr. W. H. Blood, Jr., the sense of the meeting with reference to the matter of making the grounding of circuits mandatory was taken, for the guidance of the committee when the other details, such as proper grounds, voltage, etc., were agreed on. The opinion as expressed in the vote was that grounding should be made mandatory. The National Electrical Inspectors' Association were not in favor of making the grounding mandatory, and it was the wish of the Underwriters' committee that the other bodies represented in the conference should also report to it the sense of their organizations with reference to the matter for its guidance.

The following suggested changes in the rules were adopted: The fine print note under rule 2, section *a*, was amended to read as follows: "Wires from generator to switchboard may, however, be placed in conduit, provided that proper precautions are taken to protect them against moisture and mechanical injury. If lead-covered cable is used no further protection against moisture will be required, etc." Section *c* of the same rule was amended by inserting the words "where not in conduit" after the first word. The last sentence of the fine print note in rule 12, section *g*, was amended to read: "The outer or weather end of conduit is to be provided with approved devices having wires separated and bushed through porcelain."

A number of changes were made in rule 24. Section *a*, with fine-print note, was stricken from the Code; section *o* was amended by making the first recommendation "a turn of 90 deg., etc."; section *p* was amended so as to restrict the number of different circuits in the same conduit to four two-wire or three three-wire; section *x* was changed by substituting the word *or* after the word *fastenings* for *of*. Rule 24A was also changed somewhat. Section *d* was amended so as not to prohibit the installation of armored cable without the lead covering in buildings of fireproof construction in locations free from moisture; the word "underground" was omitted from the first line of the fine-print note under section "a." A new section was added as follows: "All bends must be so made that the armor of the cable will not be injured. The radius of the curve of the inner edge of any bend not to be less than 1½ in."

Rule 28, section *e*, was amended so as to exclude flexible cord from show cases as well as show windows; the fine-print note under section *g* was omitted. A number of minor changes were made in the rules governing the wiring of theaters, principally in inserting the words "or armored cable" so as to permit the use of the latter as an alternative to rigid conduit. The other changes have to do with the details of construction, fitting, etc. Among the miscellaneous suggestions adopted were the following: All self-fastening knobs, cleats and supports must be secured by suitable screws; wires in molding must be in continuous lengths from outlet to outlet or from fitting to fitting; sockets or rosettes cannot be used to dead-end a circuit; soapstone can be used as an alternative for slate or marble; and ends of flexible wire need not be soldered before insertion under binding posts, as called for in rule 14, section *c*.

Surges and Oscillations on Transmission Systems.

In a paper read before the New York Electrical Society last Friday evening, Mr. Ernest J. Berg discussed the various phenomena in the nature of surges and oscillations met with in high-tension transmission systems. He discussed the subject under the heads of instantaneous abnormal voltages and currents due to energy stored electromagnetically and electrostatically; surges caused by grounds; surges due to arcing grounds; statics caused by grounds; abnormal voltages caused by triple frequency e.m.f. in transformers, and corona effects. The electromagnetic and the static energy stored in a circuit were compared to the mechanical energy stored in a moving body. It is no more possible to change the current or voltage of an electric system than it is to change the speed of a fly-wheel without supplying or consuming energy. If the current in an inductive circuit could be interrupted instantaneously, the voltage would rise to infinity, and if capacity is present there will be a corresponding current flow. On the interruption of the current the electromagnetic energy is converted into electrostatic energy, and this in turn is reconverted into electromagnetic energy, causing current flow. Where there is no resistance in the circuit the current would flow indefinitely, but since there is always resistance present the energy is dissipated in heat and the oscillations finally cease.

The phenomena associated with grounds on one of the transmission wires or with temporary emergency transformer connections were explained by the aid of blackboard diagrams. When one transmission line is grounded, "static" appears at the switchboard, at the generator and in general in the secondary network, and the instruments, transformers, motors and generators are liable to be damaged thereby. A ground on a high-potential line usually causes considerable disturbance on telephone lines.

Mr. Berg pointed out that with certain transformer connections a triple-frequency e.m.f. is induced in the transformer which, although not affecting the voltage between the lines, affects the potential stresses of the windings against ground. These e.m.fs., however, are not incidental to high voltages, but are of much more importance in high-voltage systems due to the usually lesser margin in insulation.

Arcing grounds, Mr. Berg pointed out, are always more destructive than positive grounds since they involve a train of oscillations, the circuit being made and interrupted with great frequency. The stresses caused by such grounds depend much upon the transformer connections.

Experiments have proved that with parallel conductors air insulation breakdowns and corona effects appear at a potential gradient of 100,000 volts per inch at atmospheric pressure. With rubber or varnished fabric corona takes place at higher voltages than in air. It was shown to be practically impossible to insulate a wire of small gage for very high voltages. Corona manifests itself in a glow, and among other effects it turns small wires black, while larger ones remain bright. It is thought that the formation of nitric acid is an accompaniment of the corona.

Marseilles International Exposition.

Arrangements have been completed whereby the international exposition at Marseilles will be supplied with electrical energy from the power houses of the two companies which supply the city of Marseilles. Each of these will supply from 1000 to 1200 kilowatts of three-phase currents at 5000 volts. About 25 transformers will be installed in small kiosks scattered

ALLEGORICAL REPRESENTATION OF ELECTRICITY.

through the park, which will supply secondary circuits for lighting the grounds. A 600-hp Rateau-Brown-Boveri electric pump will furnish the water for a large electrical fountain. The general lighting of the grounds will be by means of 350 arc lamps and about 40,000 incandescent lamps. The accompanying illustration shows an allegorical representation of electricity which will be one of the decorations of the Palais de l'Energie.

Tests of Internal Combustion Engines.

Data bearing upon the fuel consumption of small internal engines are always of interest. Below are given the results of tests upon pumping plants at Westford, Wrentham and Wareham, Mass., by Mr. E. M. Blake, of Boston:

At Westford a 50-hp Olds horizontal gas engine, a 40 to 60 hp suction gas producer and an 8 x 12 in. Smith-Vaile vertical triplex pump installed by the Westford Water Company were tested. The results of a 24-hour continuous pumping test, the producer being fed with anthracite pea coal and the fires operated under exactly normal conditions, were most satisfactory. The equipment ran without a hitch. At 80 per cent of full load, the conditions prevailing during the run, with an average delivery of 282.8 gal. per minute, against an average total head of 416.21 ft., including friction and suction, the duty, based on 100 lb. of coal actually burned in the producer, and allowing 1 per cent slip on the foot-pounds of work actually done by the pump end, was approximately 146,000,000 ft. lb.

In the Wrentham test, a single 25-hp Mietz & Weiss fuel oil engine, direct-connected to an 8 in. x 10 in. Smith-Vaile vertical triplex pump was tested. At three-quarters load, the condition prevailing during the test, with a delivery of 262.3 U. S. gal. per minute against an average total head of 197.88 ft., including friction and suction, the fuel oil consumption averaged 1.95 lb. per hp-hour, based on the horse-power developed at the pump end.

At Wareham, the engines tested were two 25-hp Mietz & Weiss fuel oil engines, direct-connected to two 8 x 10 Smith-Vaile vertical triplex pumps. At approximately three-quarters load, with a combined delivery of 525 U. S. gal. per minute, against an average total head of 201.14 ft., including friction, etc., the fuel oil consumption averaged 1.93 lb. per hp-hour.

Power Station in Indiana Coal Fields.

Frank Fauvre, Paul White and other capitalists of Indianapolis, who are preparing to build and equip a large central power plant in the bituminous coal fields of Indiana, southeast of Terre Haute, in order to have a ready market for the sale of energy developed at the new plant, have acquired the property of the People's Light & Heat Company, of Indianapolis. This company has a franchise covering the entire northern portion of the city, and runs for a period of 25 years.

By building this power station at the coal mines it is claimed that there will be a saving of at least $41,300 per year in freight rates and taxes incidental to such a plant built and maintained in Indianapolis. The officials estimate that an 8000-hp plant would consume about 82,600 tons of coal a year, which would cost, freight rates included, $41,300 per annum put down in Indianapolis, against $6,000 at the mouth of the mine, making possible a saving of $35,300 per annum. There will be a small loss in transmission to Indianapolis, requiring about 10 per cent more coal to be burned in order to equal the output of a plant of the same size at Indianapolis.

It is stated that the railroads at times are unable to deliver coal shipments promptly, thus entailing considerable loss to the industries depending upon the electric plants for energy. The new central-power plant will be able, therefore, to produce electrical energy at a low rate for a large territory.

The officials say that many factories came to Indiana during the natural-gas days, and more will come and old ones started when electric power is furnished at a reasonable price, and that is what their organization proposes to supply. The company's principal business will be with the mills and factories. It claims to have already received orders for over 3000 horsepower without any solicitation whatever.

The transmission line from the plant at the coal mine to Indianapolis will be about 100 miles in length. It will pass through a thickly settled district, having a number of towns and cities to be supplied. When this territory, including Indianapolis, is taken care of, the plan is to turn toward Vincennes, Evansville, Louisville and eastern Illinois.

The company is capitalized at $1,000,000. In addition to the acquisition of the People's Light & Heat Company, the organization has taken an option on 500 acres of coal land. Arrangements are now being made for an early construction and equipment of the central station.

New Edison Contract for City of Boston.

The Edison Electric Illuminating Company, of Boston, has succeeded in securing a contract with the city for the lighting of its municipal buildings on the company's regular schedule of rates. The cancellation of the old contract was made on March 28 by Counsel Babson for the city, and this will save Boston about $1,000 a month, beginning with the April bills. For about four years the company has been endeavoring to bring the city authorities to appreciate the advantages of taking current at the standard rates. Mr. E. W. Burdett represented the company in its negotiations. The new schedule is the one given by the company in every city in its territory for the lighting of municipal buildings. The conditions of use govern the rates in every case.

Under the new arrangement some of the departments will be obliged to pay somewhat more than others, but the average for all will be a saving, as indicated. It is expected that by rearrangement of lamps and the substitution of more economical lamps, the cost of lighting will be materially reduced in some cases. The old street-lighting contract, which provides for a maximum return of 6 per cent on the investment, is still in force, although the arbitration provided for under the terms of the street-lighting contract every 2.5 years saved the city over $10,000 per year recently. It is hoped by the company still further to reduce the cost of lighting or else to provide more light at the same cost through the use of improved lamps.

"Breakdown" Consumers Express Views.

Public Service Commissioner Maltbie, who is conducting the gas and electric companies investigation in New York, held an informal conference on Wednesday, March 25, with the users of "breakdown" electric service. The points brought out in the previous hearings with the electric companies were discussed and various plans with regard to the supply and price of "breakdown" service were considered. Commissioner Maltbie said afterward that no final conclusions in regard to "breakdown" service had been reached as yet by the commission.

New York City "Break-Down" Service.

A hearing was held before Commissioner Maltbie, of the New York City Public Service Commission, last Friday on the subject of "break-down" service. The New York Edison Company made a proposal by which it modified its previous break-down rates as set forth in a letter to the commission on Jan. 16, so that the basis of charge should be for the maximum demand of the break-down consumer rather than on the basis of the entire installation as formerly. Mr. W. W. Freeman of the Brooklyn Edison Company was called to the stand and handed the commissioner a memorandum of the present number of break-down customers supplied by the Brooklyn Company. The memorandum showed that there are six consumers under special contract at rates of 6, 5 and 4 cents, using 503,248 kw-hours, with total charges of $24,158.40, averaging 4.8 cents per kw-hour. The Brooklyn Edison Company supplies four retail consumers using 8,958 kw-hours, with total charges of $1,048.40, an average of 11.8 cents per kw-hour, making a total of 10 consumers using 512,206 kw-hours, with total charges of $25,206.80, averaging 4.92 cents per kw-hour.

A summary of break-down connections for 1907 of the New York Edison Company showed that there were 105 retail customers with installations of 3778 kilowatts and a consumption in kw-hours of 728,447, which was billed for $69,959.54, an average return per kw-hour of 9.62 cents, or an average return per kilowatt connected of $18.52. For 1907 there were 40 retail power consumers, nine of which used power exclusively, consuming 240,805 kw-hours, and billed for $18,896.31, an average return per kw-hour in cents of 7.85 and an average return per kilowatt of connected installation of $19.34. For the eight wholesale power users the installation was 2041 kilowatts, with a consumption in kw-hours of 2,416,973.1, billed for $100,337.76, an average return per kw-hour of 4.15 cents, and average return per kilowatt of connected installation of $49.16, making a grand total of 153 consumers, with 6796 kilowatts of installation, consuming 3,386,256 kw-hours, paying $189,193, an average return per kw-hour of 5.58 cents, and an average return per kilowatt of connected installation of $27.84.

Mr. J. W. Lieb, Jr., vice-president of the Edison Company, said that there was no record of the load curve of break-down consumers, nor data to show what amount of generating or distributing plant was required for this class of consumers. He handed to the commissioner a modification of the memorandum of break-down service rates which were contained in a letter to the commissioner dated Jan. 16. Mr. Lieb's memorandum stated that break-down service would be furnished to any applicant operating a private plant under the following conditions: (a) A service charge of $30, including the supply of current at the best rate of the class for each kilowatt of maximum demand. (b) The maximum demand to be controlled by a special "limit service" switch which will be adjusted so as to allow the customer to use up the capacity for which he specifically contracts. (c) The load for which the customer contracts will be a "balanced load"—that is, a load which will be taken up in approximately equal quantities from each side of the 3-wire system. (d) For each installation of break-down or reserve service of capacity less than 10 kilowatts of maximum demand, the company will charge $75 for introducing the "special limit" switch and protecting device. (e) The customer is to provide the incandescent lamps for original installation and renewals, carbons and trimmings, and for the maintenance of arc lamps, the company to assume no responsibility for installation; an allowance to be made offsetting the supply of incandescent lamps under each of the wholesale forms of contract, and where the service is taken under retail contract, a special reduction of 1 cent per kw-hour will be made in view of the customer's relieving the company of the supply and care of the incandescent lamps or arc lamps. (f) The above conditions do not refer to any installation or part of an installation permanently segregated from the private plant and connecting directly and permanently with the service of the company. Such installation may be supplied under direct contract, at the best rates obtainable by any other consumer under like conditions, using an equal amount of current. The memorandum stated that this rate was experimental and might be revoked at the end of the year.

The conspicuous feature of the modification suggested by Mr. Lieb is that a consumer may specify the maximum demand of current required instead of contracting for the whole installation as formerly, and the rate is based on that demand; including the expense of lamp, renewals, trimmings, etc., the charge for current would be 9 cents per kw-hour. The service charge of $30 contained in the former offer, including the current, would be maintained, Mr. Lieb said, but if after a year of experimentation with ammeters it was found that this rate was too high, the company would be willing to consider a modification. "In making this radical change," Mr. Lieb said, "we have given the greatest consideration to the suggestions that have been made to us, and any information which we could obtain to throw light on the subject, with the result that the modification made accords to what we consider to be the very lowest rate for that class of service and makes it possible for the customer to obtain every advantage from it." He said that the company would accept payment at the rate of $2.50 a month on the $30 a year charge, and that the consumer was privileged to use up to the maximum demand at any time during the year without extra charge. The company was willing to make break-down connection under this new rate as soon as it learned that the modification would be acceptable to the consumer. Mr. Maltbie pointed out that the commission could not formally approve of a rate, and that it had taken up the matter merely with the intention of bringing the company and the consumer together.

The Tungsten Lamp.

In an address before the New York section of the American Electrochemical Society, delivered by Dr. Clayton H. Sharp, March 27, the following considerations relating to the tungsten lamp were presented:

There are certain main difficulties in producing a filament from a material like tungsten due to the fact that the tungsten is not ductile and unites readily with oxygen or carbon. Hence it is the practice to produce filaments from tungsten in the form of a very fine powder which is held together by some sort of binder which can be removed after the filament has been squirted; this removal must leave the filament free from oxygen and carbon. A number of processes have been described. The first to appear was that of Kuzel, in which a collodial solution of tungsten is formed by making an arc between tungsten terminals under water. This solution when of the proper consistency is squirted into filaments which consist entirely of pure tungsten and water. When the water has been driven out, the tungsten particles can be sintered together by heating the filament by means of the electric current in an atmosphere containing no oxygen. In Welsbach's process, an organic binder is used to make a paste which can be squirted through a die. The binder is removed by heating in an atmosphere which will oxidize the carbon and which contains at the same time sufficient hydrogen to reduce any tungsten which may have been oxydized. For the Just-Hanaman process, a very fine filament of carbon is heated in an atmosphere of chloride of tungsten and hydrogen. This results in a deposit

of tungsten upon the filament or a substitution of tungsten for carbon. The carbon must afterward be removed by some such process as indicated above. In the "Z" process, a binder of collodion is used which can be made to burn itself out entirely. It has been found possible also to use binders of paraffine, which material can be removed simply by heat; or a slow melting metallic alloy may be used as a binder, the foreign metals being driven off by heat. An account was given of the results of a manufacturer's test on 15 series tungsten lamps in which the average candle-power did not change during 2135 hours of burning. Of these lamps, five survived at the end of the test and only three had actually burned out.

New York Lighting Investigation.

At the hearing on Monday, March 30, of the New York City Public Service Commission, the general subject of light and power was considered, with special reference to the number of contracts and rates charged by the various New York City companies. Messrs. Arthur Williams, H. M. Edwards and J. W. Lieb appeared for the New York Edison Company; Mr. Frank W. Smith for the United Electric Company; Mr. W. W. Freeman for the Brooklyn Edison Company; Mr. Henry E. McGowan for the Flatbush Gas Company; Mr. J. T. Cowling for the Westchester Lighting Company; Mr. E. H. Rosenquest for the Bronx Gas & Electric Company; Mr. C. G. M. Thomas for the New York & Queens County Company; Mr. Carleton Macy for the Queens Borough Company, and Mr. W. J. Norton for the Richmond Light & Railroad Company. All those who appeared handed to Commissioner Maltbie memoranda showing the number of current contracts on the books of their respective companies, and were questioned in respect to the details. The hearing was adjourned until Thursday, April 2.

Proposed Illumination for Denver Plaza.

A large central plaza or civic center is proposed for Denver by those interested in civic improvement. The plan calls for the occupancy of about six city blocks immediately west of the state capitol, upon which about $15,000,000 is to be expended for grounds and buildings. A plan for the illumination of this plaza has been prepared by Mr. R. Garland Gentry, illuminating engineer of the Denver Gas & Electric Company. In the plans which he outlines, which have appeared with large illustrations in Denver papers, a certain amount of outline lighting is provided on the principal public buildings, such as the stadium, mint, public library and state capitol. For the lighting of walks and drives he recommends a post of moderate proportions and conventional design equipped with incandescent lamps of some modern type, such as Gem, tantalum or tungsten, spacing these poles about 100 ft. apart diagonally across streets and driveways. This he strongly recommends in preference to arc lamps. A park or plaza is a resting place, and a soft, well-diffused illumination should be provided. This could be accomplished with incandescent units equipped with translucent globes of some familiar type of glassware. Colored lighting effects could be obtained in the fountain and sunken gardens.

Sign Business in Shreveport, La.

Shreveport, La., is one of the few cities where the policy is pursued of pushing flat-rate sign business to come on after the peak. With a total of 24 signs containing 2743 2-cp lamps, 12 signs containing 1739 lamps, are on flat rate, and burn from 7 to 11 o'clock during the winter months. By this means a load of 22 kilowatts is kept off the peak. No great difficulty was experienced in doing this, and the objections of a few consumers were met with the argument that the company was willing to make a lower rate for off-peak business.

On flat-rate signs the company makes a rate of 15 cents for each 2-cp lamp. The 24 signs bring a gross yearly revenue of $2,787, and $2,238 of this is obtained from the 12 flat-rate signs.

Public Utilities Accounting.

A hearing was held before Commissioner Maltbie, of the New York City Public Service Commission, on March 26, on the subject of uniform accounts for gas and electric companies. Those who appeared formally before the commissioner were Mr. A. F. Weber, statistician to the Commission of the First District; Mr. Forrest E. Barker, of the Massachusetts Board of Gas and Electric Light Commissioners; Mr. William J. Meyers, statistician for the Second District Public Service Commission; Mr. W. J. Hagenah, statistician for the Wisconsin commission; Mr. H. M. Brundage, for the Astoria Light, Heat & Power Company; Mr. F. S. Dame, representing the Des Moines Electric Light Company, and member of the National Electric Light Association; Mr. A. F. Stanford, representing the Brooklyn Union Gas Company, Jamaica Gas Company, Richmond Hill & Queens County Gas Company, Woodhaven Gas Company, Newton Gas Company, and the Flushing Gas Company; Mr. James Gillman, assistant auditor of the Brooklyn Union Gas Company; Mr. John L. Bailey, of the Baltimore Consolidated Gas, Electric Light & Power Company; Messrs. E. J. Allegaert and P. S. Young, of the National Electric Light Association; Messrs. A. S. Knight and L. M. Wallace, of the Boston Edison Electric Illuminating Company; Mr. G. W. Curran, of the American Gas Institute; Mr. J. W. Fernley, of the New York & Richmond Gas Company; Mr. J. J. Humphreys, of the Brooklyn Borough Gas Company and member on the commission of public accounting of the New England Association of Gas Engineers; Mr. M. M. Graham, of the New Amsterdam Gas Company; Mr. G. G. M. Thomas, of the New York & Queens Gas Company; Mr. J. E. Sanborn, of the New York Mutual Gas Light Company; Messrs. M. M. Flook and M. E. Johnson, of the Kings County Lighting Company; Mr. H. M. Edwards, auditor of the New York Edison Company, and chairman of the committee on the uniform system of accounts of the National Electric Light Association; Mr. W. W. Freeman, vice-president, and Mr. P. R. Atkinson, treasurer, of the Brooklyn Edison Company, and Mr. W. H. Gardiner, chairman of the committee on uniform accounts of the New England Association of Gas Engineers. In addition there were others present from various parts of the country interested in the subject of uniform accounting.

The tentative system of accounts, issued by the Public Service Commission, was taken up and each item carefully discussed. Every one who desired had a chance to make whatever suggestions he deemed appropriate. The commissioner noted the suggestions made, and at the close of the hearing it was announced that a conference would be held soon between the statisticians of the First and Second Districts of the New York Public Service Commission and the various other persons representing the other commissions and those interested in the subject of uniform accounting, to discuss further the suggestions and the proposed amendments made at the public hearing.

CURRENT NEWS AND NOTES.

NEW YORK CITY MUNICIPAL LIGHTING PLANT SHUT DOWN.—The refuse destructor electric lighting plant erected several years ago under the Manhattan end of the Williamsburg bridge has been abandoned. It was found that the cost of coal necessary to burn with the garbage to keep up steam was so great that, together with other expenses, the cost to generate current greatly exceeded the rate at which it could be purchased from the New York Edison Company.

GASOLENE-ELECTRIC MOTOR-CAR TRIAL.—A trip from New York to Philadelphia was made March 29 by a Strang motor car, the time being two hours and five minutes. During part of the trip a speed of 59 miles per hour was maintained. The equipment consists of a six-cylinder gasolene engine direct-connected to a direct-current generator, which latter supplies current to motors on the axles of the cars.

APPLICATION OF ELECTRICAL HEATING TO TEXTILE WORK.—A patent was issued March 24 to C. T. Kaisser and Lew Francis on an electric heating device for singeing or burning off the down or nap of fabrics, which work has hitherto been done by a naked gas flame.

THE OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION will hold its second annual convention in Guthrie, Okla., on May 25, 26 and 27. An exhibit of electric and gas appliances will be one of the features of the meeting. There will be no charge for electric current or gas for exhibiting purposes. Mr. Galen Crow, of Guthrie, is secretary.

PIONEER THEATER ELECTRIC LIGHTING.—The celebration last week of the forty-third anniversary of the beginning of the managerial career of Tony Pastor, the dean of American vaudeville, recalls that his Fourteenth Street house was one of the first theaters of the world to be lighted by electricity and the first to use the electric sign for advertising purposes. The same sign, "Pastor's," still hangs at right angles to the street before the Fourteenth Street Theater.

SMALL CANDLE-POWER TUNGSTEN LAMPS.—In reference to a statement in an editorial in the issue dated March 28, to the effect that in this country tungsten lamps have been mainly made in the 100-watt size, we are informed that the tungsten lamp factory of the National Electric Lamp Association in Cleveland has made nothing but 110 and 60-watt lamps since it was started, and that there are probably more 40 and 60-watt tungsten lamps in the United States to-day than 100-watt tungstens.

ELECTRIC SIGNALS LESSEN ACCIDENTS.—The report for January of the Union Pacific Railroad shows that for the 1,500,000 engine-miles of the road the total cost for train accidents was only $1.088 per mile. This excellent showing is attributed to the use of block signals, hand power and pneumatic systems having been displaced by electricity. The railroad had expended $2,000,000 for the installation of safety appliances and under the improved system it is practically impossible for the operator to give two trains the right of way at the same time.

ELECTRIC BALL OF FIRE.—A despatch to the *Cleveland Leader* from Bellefontaine, Ohio, stated that a meteor having the appearance of a ball of fire, fell in that place on March 18 and exploded with a terrific report. Further inquiry developed that on the date given an electric storm of unusual severity passed over the town, and from a responsible source we are informed that a "ball of fire about the size of a quart cup descended from the insulator of a telephone pole to within three feet of the sidewalk, where it exploded with a loud noise, but without doing any damage."

NATIONAL CONFERENCE ON STANDARD ELECTRICAL RULES.—The annual meeting of the National Conference on Standard Electrical Rules was held at the Edison Auditorium on Friday afternoon, March 27. Delegates from the various associations composing the conference were in attendance, and in accordance with the request of the National Board of Fire Underwriters the sense of the meeting was taken with reference to making the grounding of low potential circuits mandatory. The consensus of opinion was that if a good, reliable ground could be procured, grounding should be required; but if not, grounding should not be insisted on. Mr. W. H. Blood, Jr., was re-elected president and Mr. C. J. H. Woodbury secretary of the conference.

MERCURY VAPOR APPARATUS.—Two patents were issued March 24 to O. O. Kruh, of Schenectady, N. Y., on mercury vapor electric apparatus which involve new dispositions of the electrodes. In one patent the device described has a pair of anodes, each located in separate and opposite chambers in the walls of the main tube, while a tube extending past the anode openings contains the cathode. In this manner the discharge or arc blast from the cathode is extended beyond the anodes, thus preventing any tendency toward arcing between electrodes. In the second patent the anode and cathode are parallel and each contained within a double shield; one of these two shields is an open cylinder and within it is another cylinder enclosing the electrode, and having an opening on the side farthest from the opposite electrode.

PRESIDENT CASTRO CONFISCATES TELEPHONE COMPANY.—It is reported that President Castro, of Venezuela, has made another raid upon foreign rights, this time the victim being the telephone company of Carupano, which supplies telephone service for the districts of Bermudez, Arismendi and Benitez. The official reason given for the seizure of this property by government representatives was, that the telephone company was a menace to the government and to the public peace. The company had a contract with the government which gave it the privilege of exclusive operation in the districts mentioned and free service was given to the municipalities. It is said that the seizure resulted from the refusal on the part of the company to give service to certain officers of the government. The militia took forcible possession of the property, imprisoning the manager and the employees.

SOUTHERN APPALACHIAN WATER POWERS.—The United States Department of Agriculture has issued a pamphlet (circular 144, Forest Service) by Messrs. M. O. Leighton, M. R. Hall and R. H. Bolster, which discusses the relation of the Southern Appalachian Mountains to the development of water power. The various larger rivers having their sources in the Appalachians are taken up in turn, and estimates given of the amount of horse-power available for development. The aggregate or minimum horse-power is no less than 2,829,900, and it is estimated that at least 50 per cent and probably more of this power is available for economic development. This figure represents merely the minimum horse-power, and if auxiliary power were provided to supply short seasons of water deficiency, it would be profitable to develop two and one-half times this amount, and the full development of storage facilities would increase the minimum from to 3 to 30 times. While some of this power has already been developed, the proportion is so small as to make no showing when the enormous resources are taken into account. It is pointed out that the rental of 1,400,000 horse-power at $20 per hp-year is equal to a gross income of 3 per cent on a capital of $933,000,000.

DEAN BOVEY.—In commenting on the appointment of Professor Bovey, F.R.S., Dean of the Faculty of Applied Science in the McGill University, Montreal, to the responsible position of Rector of the Imperial College of Science and Technology, the London *Times* says that the governors of that institution have taken a bold step, but one for which there is ample justification. McGill University, it says, stands in the front rank of the institutions of higher education in the Empire, and this position is largely due to the organization and equipment of the Faculty of Applied Science, the credit for which belongs, principally, to the Professor of Civil Engineering, who has been Dean of the Faculty since its separate establishment in 1888. "Professor Bovey has shown not only that he can impress influential and wealthy citizens and corporations with the advantages of advanced scientific training, but that he can also successfully organize the extensive resources provided by the liberality of such donors. Moreover, Professor Bovey's appointment to the newly-established Rectorship has a wide and Imperial significance, which alone is commendable. This appointment may, therefore, be welcomed both from the practical and from the sentimental point of view, and the governors may be congratulated on having taken a step which should advance the Imperial College a stage further along the difficult path toward the realization of the high ideal which its well-wishers have imagined for it."

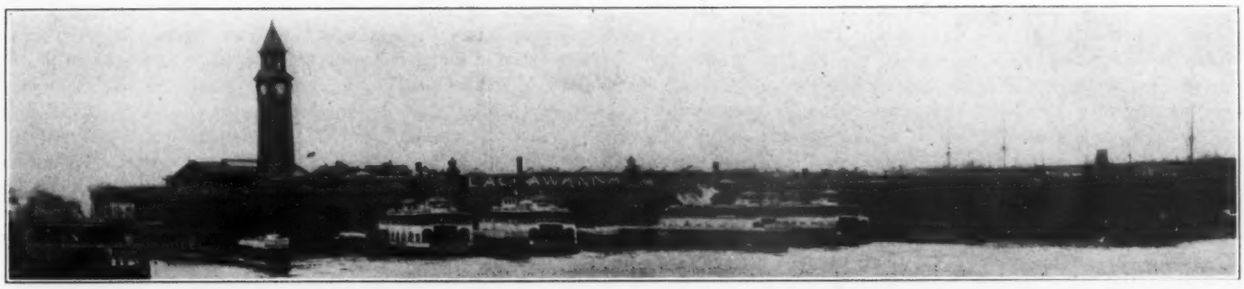


FIG. 1.—TERMINAL STATION AND FERRY HOUSE OF THE LACKAWANNA RAILROAD AT HOBOKEN, N. J.

Electrical Equipment of the Hoboken Terminal of the Lackawanna Railroad.

THE new terminal station and ferry house of the Delaware, Lackawanna & Western Railroad at Hoboken, N. J., is a steel frame structure with reinforced cinder concrete walls and floor slabs and a slag roof. The terminal is practically fireproof and is a part of the extensive improvements made at the eastern terminus of the railroad. The railroad company operates ferry lines between the terminal and Barclay, Christopher and Twenty-third Streets, New York; the ferry passenger traffic approximating 100,000 passengers daily. A large part of this traffic is between New York City and suburban towns in New Jersey reached by the Lackawanna Railroad. The terminal is a model of neatness and cleanliness and has a river frontage of 600 ft. and a width of 400 ft. to the outer ends of the ferry racks.

The general design of the structure is shown in the accompanying engravings. The ferry house is long and narrow, built parallel to the river, with the station building at one end. It is two stories high, and the ferry boats being double deckers, passengers may use either floor in embarking and disembarking. The second floor entrances to the boats connect with a 72 ft. x 450 ft. concourse ending in the station building proper. A concourse also connects with the first floor entrances and is provided with convenient exits to the station and to the street.

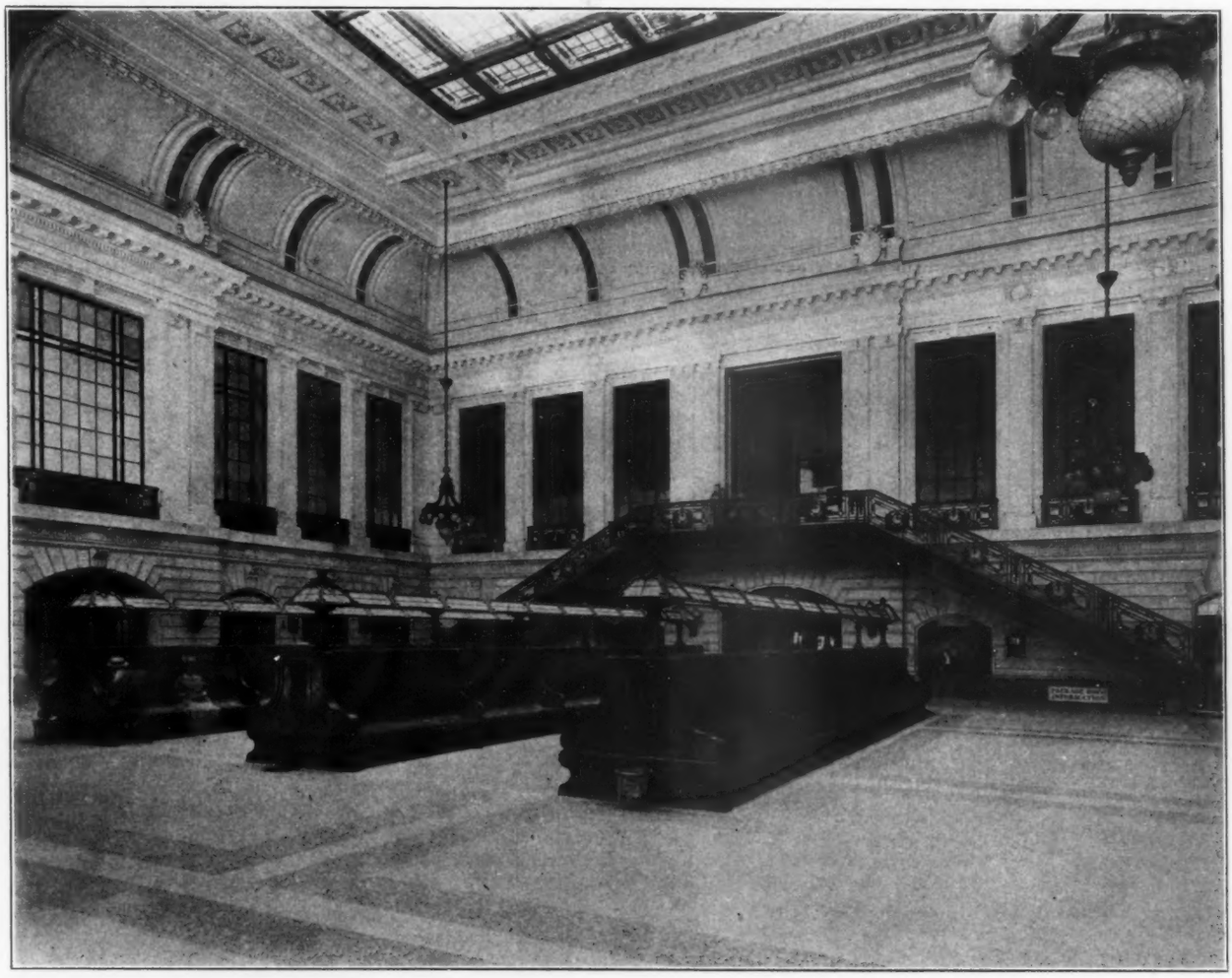


FIG. 2.—MAIN WAITING ROOM, HOBOKEN TERMINAL LACKAWANNA RAILROAD.

The concourse on the second floor is so arranged at the station end that suburban passengers may proceed directly from the boats down a flight of stairs 40 ft. wide to the trains. An entrance to the waiting room is also provided, while pas-

sengers to Hoboken have a separate exit. Similar exit arrangements are provided on the ground floor. Passengers coming to Hoboken from New York by way of the Hudson tunnels are landed just outside the train shed. East bound passengers desiring to enter the boats may pass through the first-floor concourse directly from the trains, waiting rooms or the street to the lower deck of the boats. Those desiring to reach the upper deck of the boats ascend to the second-floor concourse on an inclined plane of slight grade, or by elevators and stairways.

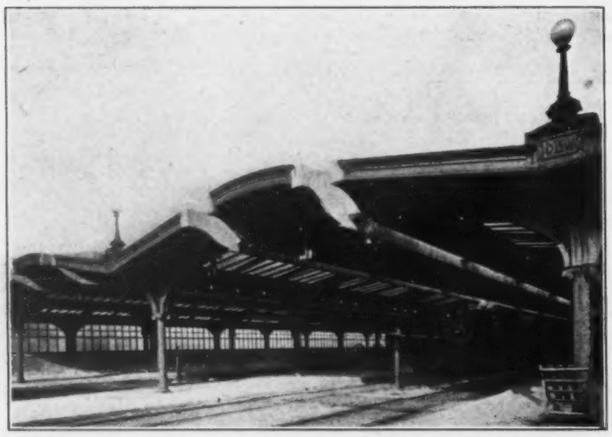


FIG. 3.—FRONT OF TRAIN SHED, SHOWING METHOD OF ILLUMINATING.

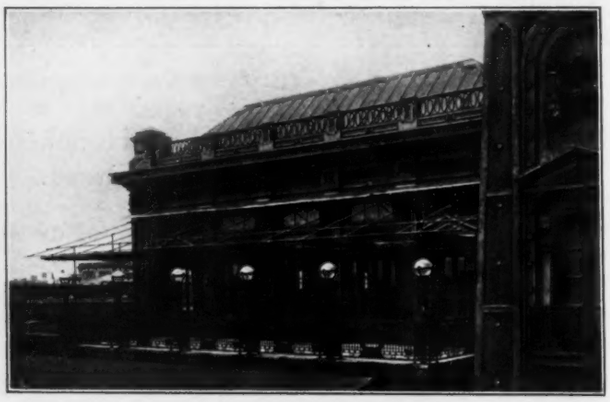


FIG. 5.—BALCONY OUTSIDE OF RESTAURANT.

The main waiting room is 100 ft. square and 54 ft. high with abundant window space on the sides and skylight in the roof. A large dining room is located on the second floor at one corner of the building and is provided with a balcony which is used as an open-air restaurant in summer extending out over the dock. The terminal has been carefully designed as regards natural light, so that only in a few places is artificial illumination necessary during the day. The 225-ft. clock tower shown is added purely for architectural effect. It is a copper shell on a steel frame and contains besides the four clocks, a large ventilating fan.

The train shed differs greatly from the usual type of train sheds in use. The shed consists of a number of low short-span, longitudinal sections built up of structural steel, reinforced concrete and wire-glass with the steel protected from locomotive gases by concrete and with copper in all places where exposed metal is required. There are 14 tracks in pairs under the train shed with concrete platforms 20 ft. wide between each pair. A longitudinal section of the shed covers each pair of tracks and half of the platform on both sides of them. The roofs are high enough to clear the highest locomotives in use on the road. The adjacent sections are supported by longitudinal rows of columns placed 27 ft. on centers down the middle of the platforms, with a transverse built-up roof girder at each transverse column row. Resting on the transverse roof girders are longitudinal purlins which support the reinforced concrete roof slab and the skylights in it. That part of the transverse girders directly over the locomotive stacks and the longitudinal purlins on both sides of the longitudinal openings in the roof over the locomotive stacks are entirely encased in concrete.

The longitudinal openings over the locomotive stacks extend the entire length of the train shed and with the exception of the crossing of the roof girders is entirely open, so the locomotives exhaust directly into the open air. A built-up section encased in a concrete slab is placed on edge on either side of the opening to direct the gases in their passage from the stacks, to protect the longitudinal purlins and to keep rain and snow from blowing in on the platforms. The tops of the locomotive

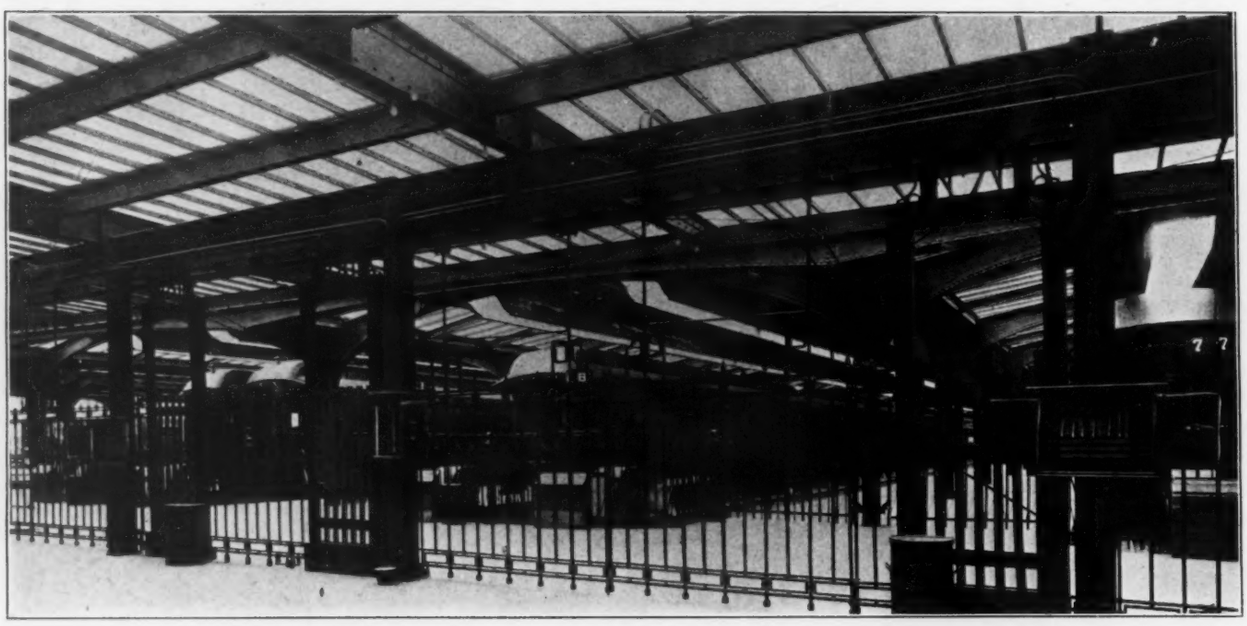


FIG. 4.—ENTRANCE TO TRAIN PLATFORMS, SHOWING DISTRIBUTION PANELS AND LAMPS.

stacks are so near the openings that practically no smoke or gases discharged from them finds its way below the shed. Three continuous skylights of wire-glass, 6 ft. wide, are placed longitudinally in the roof of each section. One of these is at the peak of the roof and admits light directly to the inside windows of the cars on the tracks below. The remaining two rows are placed over the platforms, one on each side of the tracks so as to admit light to the outside windows of the cars. The proximity of the skylights to the car windows avoids the poor light usual in most train sheds. One of the illustrations shows the excellency of this illumination.

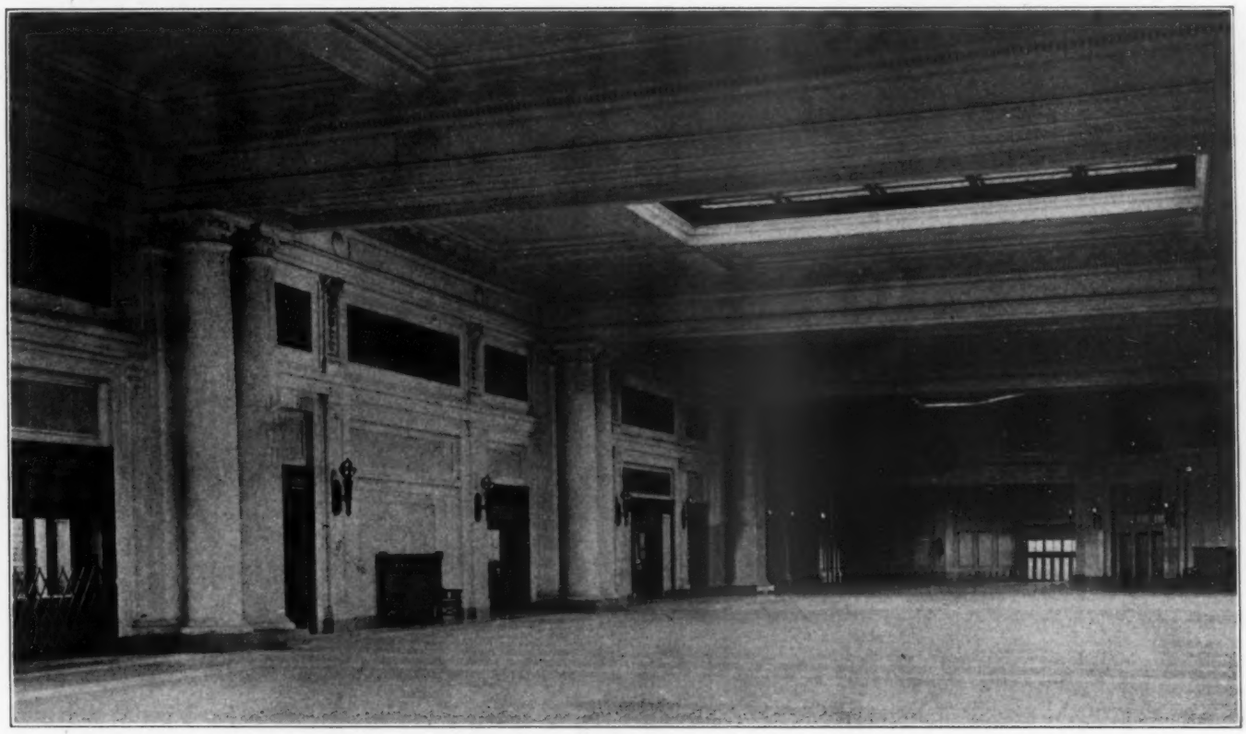


FIG. 6.—PARTIAL VIEW OF UPPER CONCOURSE IN LACKAWANNA TERMINAL.

To the left of the train sheds, and some little distance beyond, is the power house, which supplies the electrical energy for the lamps and motors in use at the terminal and the hot water for heating the various buildings, as well as the compressed air for operating the signaling and switching system.

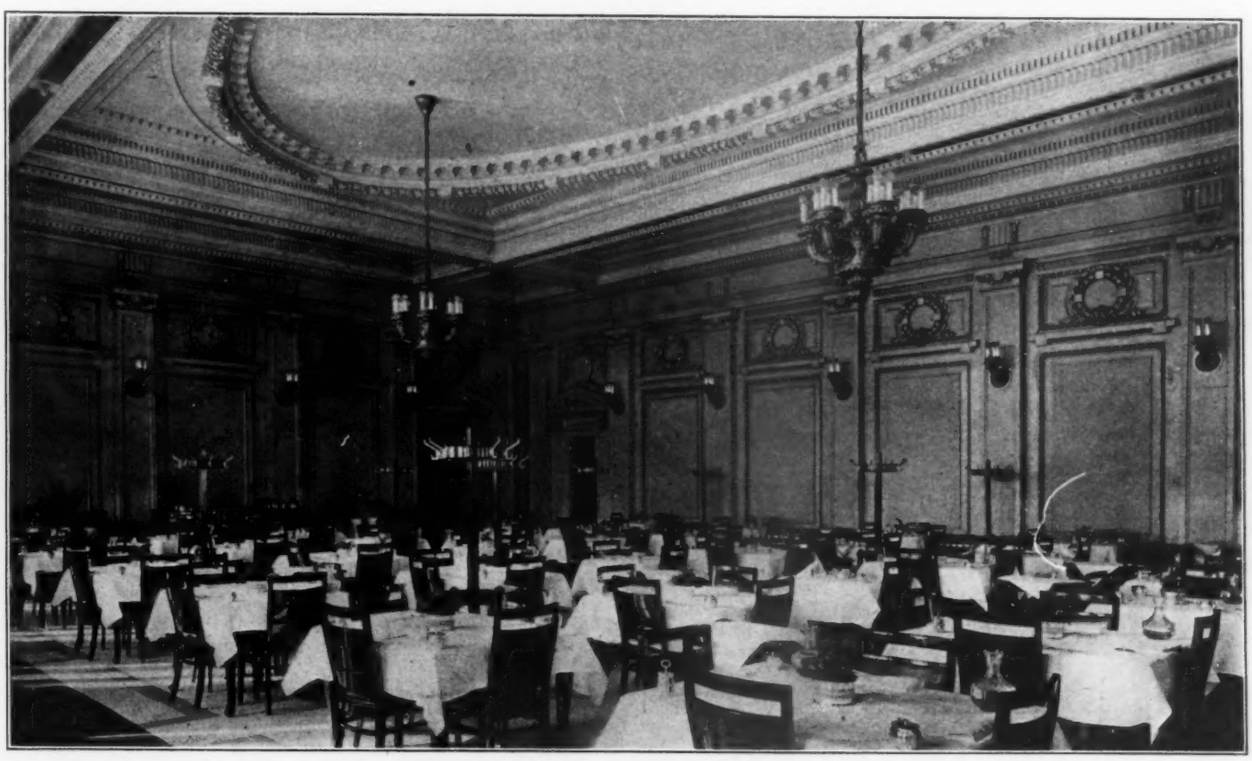


FIG. 7.—VIEW OF MAIN DINING ROOM IN LACKAWANNA TERMINAL.

The equipment at present installed consists of eight 300-hp Atlas water-tube boilers fitted with superheaters and with the Parsons system for burning the finest sizes of anthracite coal; two 500-kw Westinghouse-Parsons turbo-generators; three air compressors and auxiliary apparatus. Expansion bends connect the boilers to a main header passing through the boiler room and around the engine room in a loop, so that steam can be taken from the boilers in either direction. A feature of the header is that it is equipped with separating tees so that no separators are placed at the engine throttles. The turbines exhaust either to Worthington surface condensers or through an exhaust hot-water heater, from which the hot water for heating the depot and surrounding buildings is obtained.

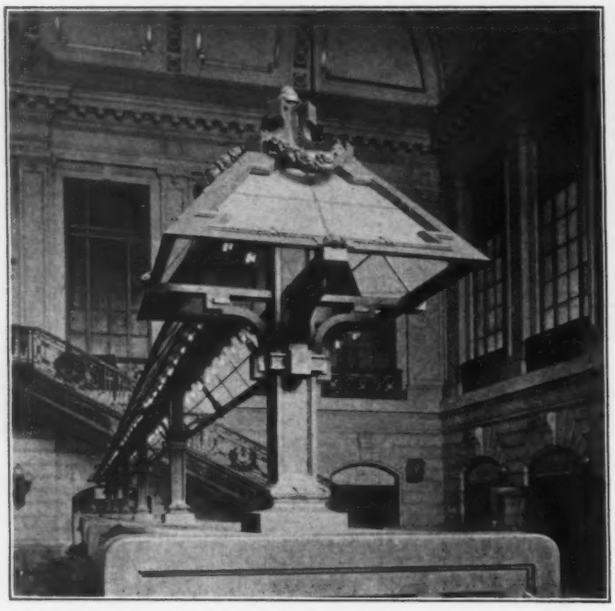


FIG. 8.—METHOD OF ILLUMINATING SETTEES.

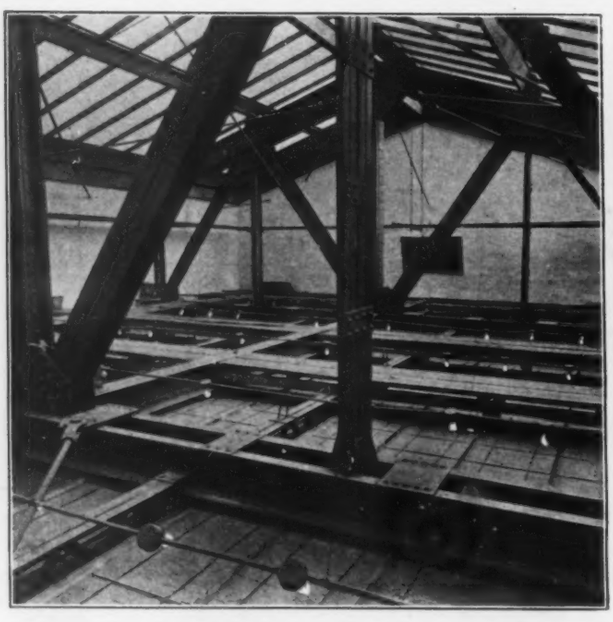


FIG. 9.—LAMPS ABOVE ART-GLASS CEILING OF MAIN WAITING ROOM.

The air compressors can also be operated condensing or the exhaust can be passed through the hot-water heater. All of the auxiliary apparatus is operated non-condensing; the exhaust passing through the boiler feed-water heater. Two exciter units are provided, one steam-driven and the other motor-driven. Each unit has a rating of 50 kilowatts. Feed water is purchased from the city, and salt water for circulating through the condenser is taken from the river through concrete ducts.

The turbines are placed on a gallery in the power house, as is also the switchboard. The turbo-generators are 2300-volt, 60-cycle, three-phase machines. The switchboard is made up of 15 standard panels of General Electric make, and is equipped with oil switches. Seven feeder panels are provided for controlling the various circuits outside the power house and two arc lamp panels for controlling the arc-lamp circuits in the yards. Three-phase current, at a potential of 2200 volts, is brought in underground conduits to two distribution points in the terminal. Here high-tension switching apparatus and step-down transformers are provided, the local distribution being on the three-wire system at 220 volts. At the terminal is also provided a 100-kw motor-generator set for supplying direct

FIG. 10.—PASSAGEWAY LEADING FROM TRAIN SHED TO UPPER CONCOURSE.

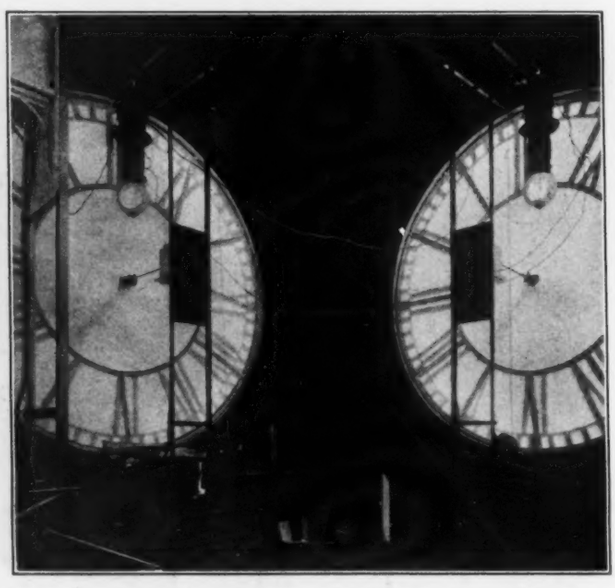


FIG. 11.—FLAMING-ARC LAMPS BEHIND CLOCKS IN TOWER.

current for the motors driving the two elevators in the station and for four ventilating fans. The large fans used in the hot-air system are driven by low-tension three-phase motors. The arrangements of circuits is such that each panel board is controlled by a separate switch on the switchboard at the distribution center, so that all lamps may be controlled from this point. The panels are arranged so that the board controls a certain defined district needing illumination at certain times, so that late at night, when only a few lighted lamps are required, these circuits may be controlled from the switchboard.

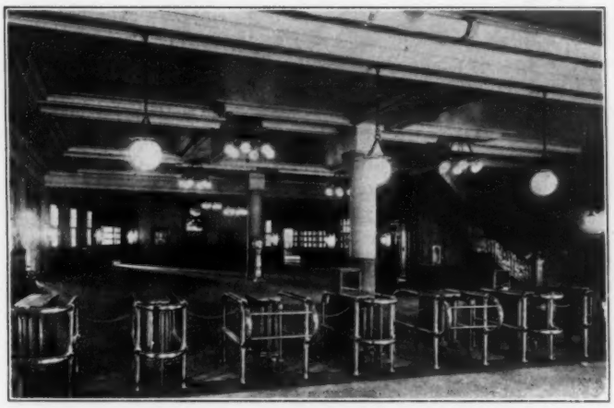


FIG. 12.—VIEW OF MAIN FERRY WAITING ROOM.

All told, there are approximately 6500 16-cp lamps in use in the terminal, besides 65 arc lamps, 60 bracket fans and 10 ceiling fans. The arc lamps are used on the ferry bridges and in the team concourses. The main waiting room, shown in Fig. 2, is lighted by four chandeliers, each holding 48 16-cp lamps. In addition there are 70 lamps above the art-glass skylight; 40 lamps in the rosettes on the ceiling; 120 clear-bulb lamps concealed in the cove, and 18 brackets containing 120 lamps. Under the art-glass shades running over the tops of the settees are 336 4-cp lamps. A view of the lamps above the settees is given in Fig. 8. The arrangement of lamps above the glass ceiling, as shown in Fig. 9, results in a spotted effect on the glass and a different scheme is under contemplation for illuminating the ceiling.

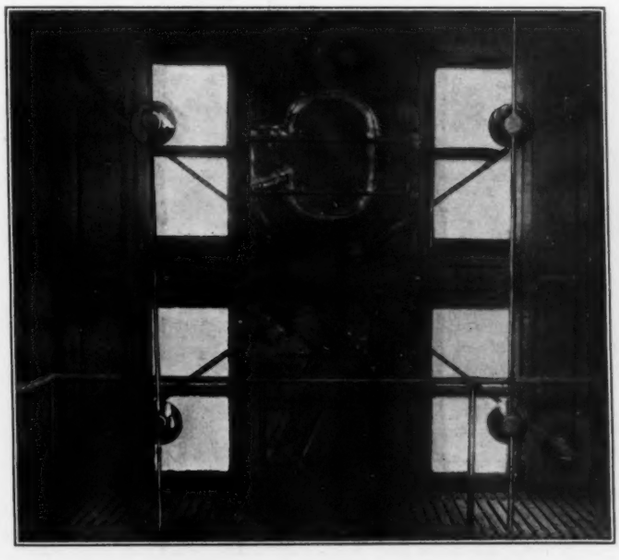


FIG. 13.—METHOD OF LIGHTING WINDOWS IN TOWER.

The upper concourse is lighted by means of 40 brackets containing 120 lamps and by means of 13 rows of incandescent lamps stretched across the ceiling on the girders. There are 903 lamps in all on this concourse. The incline leading from the train sheds to the upper concourse is lighted by three chandeliers, as shown in Fig. 10, each of which holds 17 lamps. For the illumination of the train concourse and sheds 1063 lamps are used. The lamps on the train concourse are placed beneath the steel work, and the lamps on the platforms are frosted and are spaced five to the arch, as shown in Fig. 3. At night the effect is very pretty, indeed.

In the dining room, a view of which is shown in Fig. 7, 164 frosted lamps are used, and the balcony outside, shown in Fig. 5, is lighted by 60 lamps in six pedestals and by 20 lamps in the lattice work overhead. The lamps in the restaurant are for the most part on brackets and in the chandeliers. There are 24 brackets, each holding four lamps, and two chandeliers each holding 24 lamps. There are also four six-lamp clusters on the ceiling, and 16 lamps in the square, at whose corners the clusters are placed. The chandelier shown in Fig. 6, just outside the restaurant, contains 24 lamps.

In the Lackawanna sign across the front of the ferry house are 485 4-cp lamps, and in the archway over the ferry slips 460 4-cp lamps are arranged, while along the edge of the roof 405 16-cp lamps are disposed. The tower is lighted at night by 72 lamps placed as shown in Fig. 13. Each 16-cp lamp is mounted 3 ft. back of the window and fitted with a cone reflector. The clocks in the tower are lighted by means of flaming-arc lamps, as shown in Fig. 11. At first, incandescent lamps were tried, but the face of the clock being made of such heavy glass, the results were very disappointing. It is also intended to place 16 flaming-arc lamps in series across the 2200-volt circuit and suspend them in a circle from the top of the tower on the river side. The small ferry waiting room is lighted by 10 four-lamp brackets and three 12-lamp chandeliers. The main ferry waiting room, a view of which is given in Fig. 12, has two 12-lamp chandeliers just inside the entrance, five three-lamp chandeliers over the ticket booths, 11 6-lamp brackets along the walls, and six six-lamp chandeliers suspended from the ceiling. This is the only room requiring artificial illumination at all times.

Taken altogether the illumination is very satisfactory. The arrangement of the enclosed-arc lamps in the lower concourse is not all that could be desired, and the engineers contemplate installing high-efficiency incandescent lamps instead and arranging them so as to obtain a better distribution of the light. The train sheds are well lighted, and owing to the design, are very clean. Conduit is used throughout in the wiring of the buildings and train sheds. Mr. K. M. Murchison was the architect of the terminal, and Messrs. Peet & Powers, of New York, were the electrical contractors. Mr. H. M. Warren, of Scranton, Pa., is the electrical engineer of the railroad company having direct supervision of the electrical work, and to him and to Mr. Van Patten, engineer at the terminal, we are indebted for many courtesies extended in the preparation of this article.

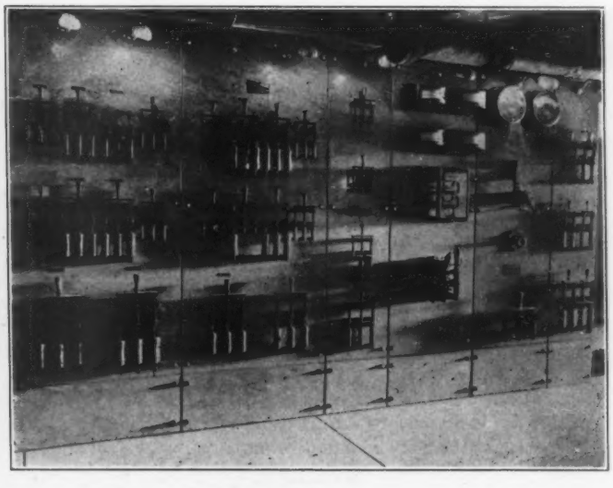


FIG. 14.—DISTRIBUTION BOARD IN TERMINAL.

Economical and Efficient Plans for Lighting Small Houses.

By J. R. Cravath and V. R. Lansingh.

MANY central-station companies are now wisely directing special effort to secure as customers the many small houses and cottages which are to be found in every city. It is coming to be more commonly recognized than formerly by central-station men that a number of such small houses per block will yield a better revenue for a given amount of investment in lines and transformers than will a few large houses. The reason for this is that the maximum demand of the large house is much larger in proportion to the number of kw-hours consumed per month than in the case of a collection of small houses. There was a time when the cost of electric light kept it out of small houses, but this reason should no longer hold. Reduction in rates, together with the introduction of fairly efficient lamps of less than 16 candle-power, puts electric light within the reach of all but the very poorest class of people, provided it is installed in a way which will give good lighting results with small kw-hour consumption.

It is much more important to use good illuminating engineering in planning the lighting of small houses than it is in large houses, because the owners of the latter can usually afford to waste more current than can the occupant of a small house. This article has been written to help the central-station company or contractor to install cheap and efficient electric-lighting arrangements in small houses. In some cases central-station companies themselves, or through special arrangements with contractors, are making special offers to wire small houses for a certain price per outlet or for a certain price for a given number of outlets, supplying fixtures, glassware and everything complete at a very low figure. In such cases it is, therefore, of great importance to the future welfare of the company that such standard lighting equipments be efficient as well as cheap, in order that the economy of electric light may cause its use to be extended, and in order that complaints may be reduced to a minimum. The designs here suggested offer several alternative plans for all of the common rooms in a small house.

FIGS. 1, 2 AND 3.—FIXTURES FOR LIVING ROOMS.

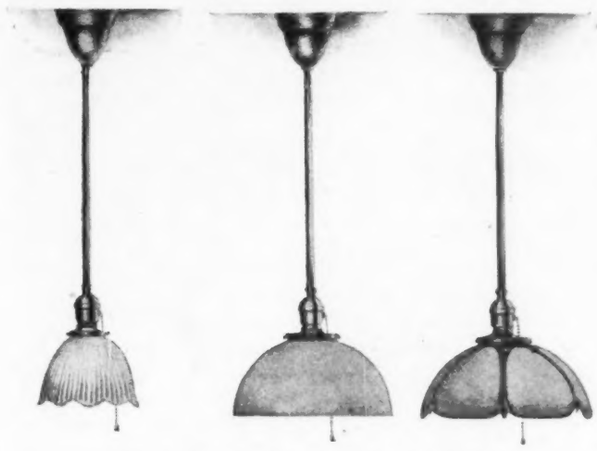
LIVING ROOM.

For the living room the kind of fixture shown in Figs. 1, 2 and 3 is recommended. Such a fixture is simple and cheap, and answers all the practical requirements of a much more elaborate fixture. The central stem of this chandelier is ¾ in., and the arms ⅜ in. outside diameter. Its cost in large quantities unwired in common lacquered brass finish is about $2.60 to $3.10, including sockets and shade holders, but not including glassware or lamps. It differs from the ordinary three-light chandelier in that all sockets are pendant (that is, pointed straight down), and one socket is placed on the bottom tip. This socket (sometimes called by fixture men a bottom tap) is an important feature for two reasons: It allows a reflector for reading purposes to be used on the center socket, while glassware suited to the general lighting of the room can be used on the arms without destroying the symmetrical appearance of the chandelier. It also permits a portable table lamp to be attached to the middle socket in a much more sightly manner than if it had to be plugged into one of the chandelier arms. The reason for making sockets pendant is partly to avoid the sagging of shades and pulling apart of sockets which are so common when sockets are placed at an angle, but it is mainly to afford better light distribution, and to make it possible to equip economically the chandelier with glassware which will prevent glare in the eyes. Space does not permit going fully into the reasons for the superiority of having pendant lamps on a chandelier of this kind, but they are sufficient to justify the complete elimination of chandeliers with lamps at an angle in houses where economy in first cost and in operation is a great object. The chandelier is equipped with pull sockets and the lower edge of the socket should be 6 ft. 8 in. above the floor. For a 9-ft. ceiling the chandelier should be 28 in. from the top of the canopy to the bottom of the center socket. This will place the socket chain within easy reach, and make it easy to turn off and on various lamps on the fixture as needed. This in itself has an important bearing on economy, especially in cheap work where switches cannot be afforded.

Another detail which should receive attention is the much-neglected matter of shade holders. A large number of the shade holders sold to-day are entirely inadequate to hold a shade or reflector in proper position. The commonest form of shade holder is made of very light, flimsy brass, with only two supports or prongs between the outer and inner portions. They are almost sure to be bent before the chandelier has been up long, and give a slipshod appearance, besides interfering with the proper distribution of light. Shade holders should be of heavy brass, and should have at least three prongs supporting the outer rim. Among the improved patented holders recently brought out, which are considerably stiffer than the ordinary varieties, are the "Hubbell" and the "J-E-M," the latter being a wire holder of considerable stiffness.

Fig. 1 shows the living-room chandelier equipped with glassware according to a plan which we shall designate as Plan A. This is probably the most efficient arrangement of those shown, and is also the most expensive as regards cost of glassware. The center socket has a Holophane reflector, and the arms are fitted with enclosing globes. The center lamp is intended for ordinary reading purposes, and with the reflector shown, with a 16-cp lamp, will give an even illumination ample for reading over an area large enough to accommodate any ordinary family. An 8-cp lamp would be sufficient with a more concentrating reflector, but the area lighted sufficiently for reading

purposes with a concentrating reflector would be very much smaller; so that in putting out a chandelier for general use where conditions are not known, it is wise to provide one which will cover a large enough area to meet all possible conditions, even though maximum economy is not attained. The reflector shown on the center socket will light up any ordinary small living room fairly well in addition to the area in the center of the room, and is, therefore, sufficient for reading purposes. To supplement this, the two lamps on the arms of the chandelier are provided with enclosing globes, which are intended to throw light into the far corners of the room when this is necessary, as, for example, to furnish a light on a piano. The enclosing globe shown in this plan is to give a general distribution of light below the horizontal. A white asbestos or mica washer should be used in the 3¼-in. shade holder to prevent dust from falling inside the globe. Such asbestos washers can be bought with the globes at less than a cent apiece. All the globes on this chandelier (Fig. 1) so cover the lamps that when persons are sitting around the sides of the room facing the chandelier, no light can fall in the eyes except the diffused light coming through the globes and reflector. The arrangement, therefore, combines efficiency with absence of glare. The total cost of the chandelier, as shown in Fig. 1, complete with sockets, shade holders and glassware, not wired and excluding lamps, is about $3.80 to $4.30 when purchased in wholesale quantities by dealers and central-station companies.



FIGS. 4, 5 AND 6.—DINING-ROOM FIXTURES.

Fig. 2 shows the same form of living-room chandelier equipped with glassware according to Plan B. The central socket has an 8-in. fluted opal cone, which has been a staple trade article for many years. The arms are equipped with a sand-blasted (roughed inside), bell-shaped shade which covers the lamp sufficiently so that the glare of the bare lamp filament is not received in the eyes. Any frosted or roughened shade of this general shape will answer the purpose here. The light distribution, with the chandelier equipped according to this Plan B (Fig. 2) is very similar to that obtained in Plan A. The glassware costs less than half as much. It might be considered by some rather old-fashioned in appearance on account of the fluted opal cone, but the lighting results with this equipment are excellent. The total cost of a chandelier equipped according to Plan B, complete with sockets, holders and glassware, not wired, excluding lamps, in large quantities is about $3.08 to $3.58.

Fig. 3 shows the same style of living-room chandelier equipped with glassware according to Plan C. The central socket has a white enameled Zalinski reflector, and the arms a bell-shaped shade roughed inside, either of the particular design shown or something similar. This glassware costs about the same as that in Plan A. The amount of light obtained in the center of the room for reading purposes will not be quite as much as in Plans A and B. The enameled reflector on the center socket, however, is a beautiful diffuser and softener of light to make up for its slightly lower reflecting efficiency. The arrangement will, therefore, be preferred by some on account of general appearances.

In Figs. 1, 2 and 3 attention is called to the fact that the center socket is equipped with a standard 2¼-in. shade holder, and not with a 3¼-in. spun holder attached above the socket, as fixtures are frequently made. The spun holder, as usually placed, is too high, costs more and is not suited to any of the requirements specified.

Plan D is suggested for the very cheapest class of work in a living room, and consists simply of a drop cord with a 6-in. fluted opal cone reflector, like that shown on the center socket in Fig. 2, but of smaller diameter, in order that the lamp will not be so completely covered by the reflector. This permits more light to be thrown around the edges of the room, which is desirable, inasmuch as only one lamp is provided.

DINING ROOM.

Fig. 4 shows Plan A suggested for the dining room. It is customary to provide a more elaborate arrangement than this for dining-room lighting, but it is entirely unnecessary for illumination purposes and money can well be saved here and put in other places to better advantage. This fixture consists of a plain, one-light pendant, ⅜ in. outside diameter, equipped with a pull socket, the lower edge of which is 6 ft. above the floor, and a substantial three- or four-prong shade holder, as suggested under the head of "Living Rooms." The Holophane reflector shown gives such a distribution of light as to illuminate with almost perfect uniformity any ordinary size of table and, at the same time, if an 8-cp lamp is used, the lamp filament is almost invisible to those sitting around the table. An 8-cp lamp is ample for any of the dining-room table lighting arrangements suggested in this article. If the top of the table is properly and evenly lighted, the illumination of the rest of the room will usually take care of itself. The cost of a fixture equipped, as shown in Fig. 4, Plan A, including socket, shade holder and glassware, is about $1.50 in wholesale quantities, not wired and not including lamps.

Fig. 5 shows a similar one-light pendant for dining-room lighting equipped according to Plan B, with a staple 10-in. opal dome reflector with 3¼-in. shade holder. The other equipment is the same as Plan A. The opal dome gives a somewhat similar distribution to the reflector shown under Plan A, except that a small area in the center of the table is more brightly lighted at the expense of the edges, and this central area will have some light and dark streaks, due to the reflection of the lamp filament from the smooth opal reflecting surface of the dome. The total cost of a chandelier, unwired, equipped as in Plan B (Fig. 5) is about $1.48 in wholesale quantities, without lamp. It is, of course, possible to light the dining room with a drop-cord equipped with either of the reflectors mentioned under Plans A and B.

Fig. 6, Plan C, for dining-room lighting, shows a somewhat costlier arrangement, in which an inexpensive art glass dome with 3¼-in. holder is used instead of an opal or prismatic reflector. It is also evidently possible to substitute a chain for the rod pendant. The cost of the unwired fixture, as shown in Fig. 6, Plan C, is about $5.65 in wholesale quantities, including everything but the lamp.

KITCHEN.

Plan A suggested for the kitchen is to place one light at the ceiling in the center, equipping with a pull socket to which a string can be attached for turning the lamp on and off. This does away with the necessity of a switch, and, at the same time, puts the lamp up where it will be most useful for general lighting of the kitchen. Of course, if cost permits, it is desirable to have a switch near the door for this lamp, as the kitchen lamp is usually turned on and off a number of times in the course of an evening. Under Plan A the lamp in the center of the ceiling could be equipped either with a 6-in. fluted opal cone or with a prismatic reflector like that shown under Plan A for the dining room. The fluted opal cone is a few cents cheaper, but will not give quite as much light at sink and range around the sides of a kitchen 10 ft. square as will the prismatic reflector mentioned. At the same time, it will give

more in the center of the kitchen than this particular prismatic reflector.

Plan B for the kitchen consists in putting in a pull socket at the ceiling over that portion of the kitchen in which most of the work is done. In some kitchens it may be possible to locate the lamp at the ceiling in one corner of the room where most of the work is done, so that it would be, of course, unwise to put it in the center. In such a case, a concentrating form of reflector should be used.

BEDROOMS.

Plan A suggested for the bedrooms is to place a pull-socket at the center of the ceiling. This then gives the occupant the choice of a number of different arrangements which can easily

FIGS. 7 AND 8.—BRACKET FIXTURES.

be changed from time to time. He can place a fluted opal cone at the ceiling, attach a string to the chain of the socket and use this ceiling lamp for the general lighting of the room. If light is wanted for reading or sewing in the center of the room, a short-length drop cord can be used to bring the lamp down, utilizing the same reflector. Plans B and C, which follow, can also be used where a center socket or receptacle is available.

Plan B consists in attaching to the central receptacle a length of portable cord, to which is attached an adjustable, portable wall bracket of the type shown in Fig. 7. This bracket can be hung on a neat brass hook at any point in the room where it is wanted, and easily changed at a moment's notice. Thus, much of the time it may be wanted directly over the dresser. At other times it may be needed at some other point for sewing, or over the bed, where it can be turned on easily in the night. This bracket, which is shown equipped with a common 6-in. fluted opal cone reflector, has a rotating adjustable stem, so that it can be turned up or at an angle. Its cost, without wire, including reflector, holder and socket, is about $1.32.

Fig. 8, Plan C, shows another neat type of portable wall bracket which has been used to no great extent, but which can be made up easily by any fixture manufacturer. In appearance it is like any simple wall bracket, except that for the ordinary canopy is substituted a solid portable stand base, to which an eye is attached for hooking over a wall hook at any point in the room. The cost of such brackets made up in quantities should not exceed $1.35 to $1.50, complete with glassware. Any concentrating prismatic reflector of light weight is suitable for use on such a bracket, as is also the fluted opal cone shown under Plan B.

BATHROOM.

For the average bathroom, the cheapest arrangement is probably a drop cord with the bottom of the socket 6 ft. 8 in. from the floor, equipped with a pull-socket, a 6-in. fluted opal cone reflector, and a turn-down type of lamp giving 8 candle-power when turned up and ½ candle-power when turned down.

HALL.

For the hall a plain pendant, like Fig. 4, with a roughed bell-shaped shade, like those on the arms in Fig. 3, is recommended. This gives good diffusion, and about the kind of light distribution needed in a hall, especially where stairs are to be lighted. The turn-down type of lamp can also be used here to advantage.

PORCH.

A cheap and efficient porch arrangement is to place a socket at the ceiling with a 7-in. opal dome reflector. This will have to be controlled by a wall switch either inside or outside—preferably the former. A 4-cp lamp will be ample for ordinary purposes. The opal dome reflector recommended is similar to that shown on the fixture, Fig. 5.

In what has been said in this article, the authors do not wish to be understood as recommending some of the arrangements specified where the owner can afford something better. It is intended to cover only the cheapest class of work. Where it can be afforded, switches should be added in as many rooms as possible. The previous articles by the authors have taken up many of the problems met in a better-class of residence work.

Improvements on Ellis Island, New York Harbor.

The finest dining room for immigrants in any part of the world was formally opened on Ellis Island, New York harbor, on Wednesday, March 18. When the new dining room was thrown open, the old system, which caused immigrants considerable annoyance, inconvenience and often was responsible for long delays, was abolished. That is to say, the six dining rooms which were in use since the opening of the busiest immigration station in the world and which were scattered over the island, are used for other purposes, and the new arrivals can take their meals while detained there in the new dining hall on the second floor of the main building.

The new dining hall can accommodate 1400 immigrants at a sitting, while under the old system eight sittings were necessary. The new dining room is well lighted by electricity and the sanitary kitchen is equipped with modern appliances and utensils for preparing food for the table. A 2-hp, 220-volt motor belted to a shaft drives a potato peeler, a food chopper and an ice-cream freezer. In addition there are two motor-driven dish-washing machines. Electricity is used exclusively on the island for illuminating and power purposes and the model isolated electric plant installed about six years ago will

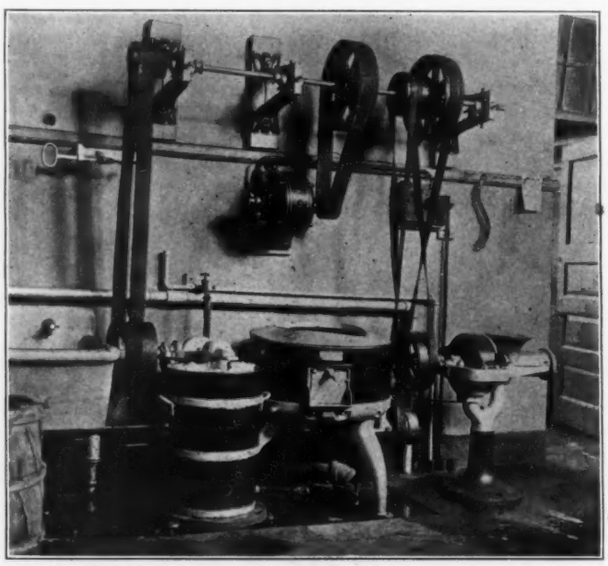


FIG. 1.—MOTOR-DRIVEN DEVICES IN KITCHEN.

soon be held in reserve and a new turbine-driven electric plant installed. Ellis Island is within 10 minutes of New York City and within about three minutes of Communipaw, N. J., although boats only ply between the island and New York. The exhaust steam from the engines is used for a number of purposes throughout the numerous buildings, so that an isolated plant is necessary. Governor's Island, close by, is supplied on the other hand with electrical energy for lighting the streets, houses and fortifications by the Edison Electric Illuminating Company of Brooklyn through a cable crossing Buttermilk Channel to a rotary-converter substation on the island.

Among the recent changes on Ellis Island is the substitution of flaming arc lamps for ordinary arc lamps for general illumination at night. Fig. 2 shows two of these lamps, which are all of the Excello type, on the wharf near the steamboat landing. The lamps are suspended from ornamental posts and there are at present in use 29 flaming arc lamps. Flaming arc

FIG. 2.—FLAMING-ARC LAMPS ON ELLIS ISLAND.

lamps are also used for illuminating the immense baggage room in one of the buildings and arrangements are being made for installing quite a few more lamps of this type around the island, which it should be mentioned is not a very large place, being used exclusively as an immigrant station.

The National Bureau of Standards; the Service That It May Render to Electrical Engineers and Central-Station Companies.

By Joseph B. Baker.

IT is estimated that of the approximately 5000 central stations in this country only about 250 are large enough to have their own general testing department. That is to say, only 5 per cent of all the central stations are well enough equipped for the work of testing their own instruments and apparatus to be independent of outside testing laboratories.

In some of these larger and more highly organized companies elaborate testing departments have been developed, with a competent technical and scientific staff, and a complete equipment of apparatus, including primary standard instruments, for all testing, experimental and research work that the company may wish to undertake. The testing department makes periodical and special tests of the switchboard and portable instruments used by the company, including instruments for the meter department, and of its own primary standards; tests the efficiency of the electrical machinery—generators, rotary converters, transformers, etc.—in the company's main and sub-stations; tests conductor and insulator resistance of the lines and cables, and the efficiency of the lightning arresters; takes indicator cards of the engines, makes analyses of the oil, coal and feed water; in short, performs all sorts of tests required to maintain the efficiency of the plant, which, but for the existence of the testing department, would require the calling in of outside engineering services.*

Contrasted with this high degree of organization is the case of the other 95 per cent of the central station companies of the country, too small or too incompletely organized to have any such department. Here, if ever, is a need for the exercise of government paternalism to assist commercial enterprise, and the valuable service that may be rendered this large number of companies by the National Bureau of Standards, by placing the scientific resources of the government at their disposal, at comparatively small cost, is the subject of the present article.

*An example of such a testing department is that of the Malden, Mass., Electric Light Company, which was described in an illustrated article in the issue of Dec. 7, 1907, page 1098.

THE INCEPTION OF THE BUREAU OF STANDARDS.

Early in the history of the government provision was made for the adoption of suitable standards of length, mass and capacity. The Treasury Department, which had charge of the work, in providing copies of these standards for the several states, through the Office of Weights and Measures, was obliged to go into the matter of thermometric standards also. But beyond this limited scope of the government's activities, nothing further was done up to a comparatively recent time. During the last years of the Office of Weights and Measures (at the time of the beginning of the electrical industries) the office began to equip itself for the testing of electrical standards, especially of resistance and e. m. f.

The gigantic growth of scientific, manufacturing and commercial interests, requiring the substitution of exact for rule-of-thumb measurements and the introduction of interchangeable methods in manufacturing, revealed the poverty of standardizing facilities that existed in this country. Foreign standardizing bureaus, notably the Physikalisch-Technische Reichsanstalt of Germany, upon which we were dependent for the exact testing of instruments of precision, set a splendid example of the value of a broad scientific institution giving a service independent of commercial considerations. The need of the establishment of a National Bureau of Standards was agitated, and in 1901 the Congress appropriated funds for the construction and equipment of laboratories and the maintenance of a scientific staff.

THE MECHANICAL AND ELECTRICAL EQUIPMENT.

A site was selected, about 7½ acres in extent, in the northwest section of the District of Columbia, about 3½ miles from the White House, and two good-sized laboratory buildings were erected and thoroughly well equipped. Fig. 1 is a view of one of these buildings, the Mechanical Building. On the ground floor is the engine room, shown in Fig. 2, containing the electrical machinery and switchboard for supplying all of the laboratories. Fig. 3 is a view of the Physical Building, in which the more delicate work is done and in which the chemical laboratories and the executive offices are located. A third (smaller) building, for use as a low-temperature laboratory, and equipped with apparatus for the liquification of gases, was added later, and other buildings are projected.

The personnel of the bureau, which numbered 110 at the beginning of the fiscal year, July 1, 1907, is selected by competitive civil service examination, and includes over 60 per cent of scientific and technical men. The above paper states: "With the exception of the leaders in the principal lines of the bureau's work, the policy has been to appoint graduates of first-class scientific and technical colleges to the lower grades of assistantships, advancing them to the higher grades as they become proficient and vacancies occur. At entrance they are allowed to select the line of work in which they desire to specialize, and every opportunity is given them for development. The leaders of several important sections of the bureau are men who entered it as minor assistants, but who were equipped with a thorough scientific training which enabled them to take advantage of the splendid opportunities the bureau offers in certain fields of scientific research."

The special electrical testing facilities of the laboratories of the National Bureau of Standards comprises a complete and modern equipment of instruments, apparatus and machinery, which is being improved and increased constantly, in accordance with the progress of the mechanical and electrical arts.

The Mechanical Building contains the mechanical and electrical plant, the instrument shop, about one-half of the electrical work, photometry and engineering testing. Two 125-hp water-tube boilers, with economizer and forced draft, are now

installed, with space reserved for additional boilers, to give an ultimate capacity of 500 horse-power. The engine equipment, shown in Fig. 2, comprises a tandem-compound engine of 120 horse-power, driving two direct-current, 37.5-kw generators, each giving 300 amperes at 120 volts and connected in a three-wire system; and a smaller engine of 40 horse-power capacity, which, like the larger engine, drives two direct-current generators. A third engine and direct-connected 40-kw, 60-cycle alternating-current generator are now being installed. The auxiliaries, installed on and under a platform in the boiler room, include steam and electric-driven high-pressure water pumps, boiler feed pumps, etc., and the filters, feed-water heater, pressure and storage tanks, etc.

The electrical machinery includes a double motor-driven booster, for charging storage cells, having a capacity on each side of 200 amperes at 30 volts, or at lower voltage and correspondingly larger current; a three-unit motor-generator set, consisting of a motor driving 60-cycle and 180-cycle, two-phase generators, giving an adjustable e. m. f. of nearly sine wave form, and considerable range in frequency and wave form by connecting the generators separately or in series; a three-unit set with 60-cycle, three-phase generators, the phase relation of which may be varied by mechanically shifting the field of one of the machines, for obtaining any desired power-factor in any instrument having a current and a potential coil; and a smaller set, similar to the preceding, giving two 60-cycle, three-phase currents of adjustable phase relation, and a three-phase 120-cycle alternator, driven by an inverted synchronous converter used as a motor, the latter also giving alternating current at 60 cycles.

There is also a new 10-unit set, consisting of two driving motors and eight alternators, all direct-connected on a common shaft, which may, however, be uncoupled in the middle so that the apparatus may be operated as two independent sets, each with its own motor. One set has three alternators, giving 60, 180 and 300 cycles, sine-wave form, and capable of being joined in series, thereby varying the wave form. The second set has five alternators, giving 420, 540, 660, 780 and 900 cycles, respectively. All the machines may be joined in series, as they have the same current capacity, namely, 35 amperes. The voltages, however, decrease gradually from 200 for the largest to 10 for the smallest. When joined in series all the odd harmonics to the fifteenth will be present in the e. m. f., or may be quickly cut out. The wave form can be varied indefinitely by varying the number of harmonics employed and their relative intensities and phases. This machine is very useful in testing and research, not only for varying wave form, but for obtaining a great variety of frequencies. The switchboard for this set is equipped with hot-wire instruments arranged to show what components enter into the resultant e. m. f. The operating switches give complete and quick control over the various possible combinations.

The main switchboard, which appears in the background at the left in Fig. 2, controls the direct- and alternating-current machinery and a combination set of storage batteries arranged in groups on the three-wire system. The batteries—which are installed in a battery room, equipped with a motor-driven exhaust fan for drawing off the fumes—are employed (a) for operating motors when great steadiness of speed is desired; (b) for lighting and power when the engines are not running, and (c) for general experimental purposes. The switchboard equipment includes also several plug panels, for distributing any of the currents to any part of the laboratories. All pipes and wiring are carried through the sub-basement, under the engine room floor, so that the engine room is free from overhead piping and wiring. This arrangement also gives free travel for the crane. A spacious subway, the concrete top of which appears in Fig. 1, connects the Mechanical Building with the Physical Building. Through this subway are carried all of the piping and wiring necessary to supply the latter building from the plant in the former building. An instrument and machine shop, equipped with individual motor-driven tools and having a force of expert mechanicians, is an important adjunct to the laboratory. Great pains have been taken to equip the laboratory rooms in all of the buildings with the conveniences—such as local switchboards, hot, cold and ice-water piping, cold-brine, gas and compressed-air and vacuum piping, and ample electric wiring—necessary for the most efficient work.

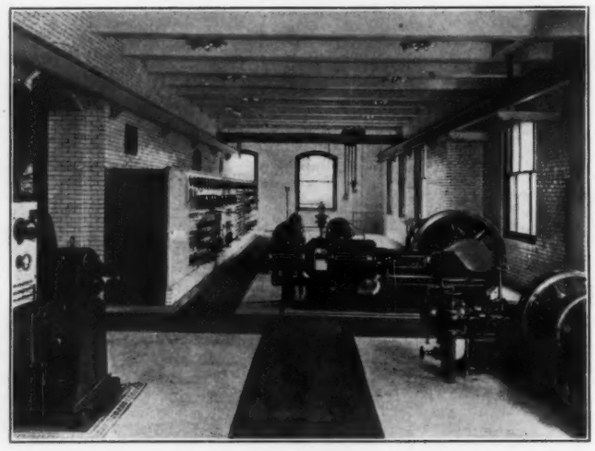


FIG. 2.—ENGINE ROOM, BUREAU OF STANDARDS.

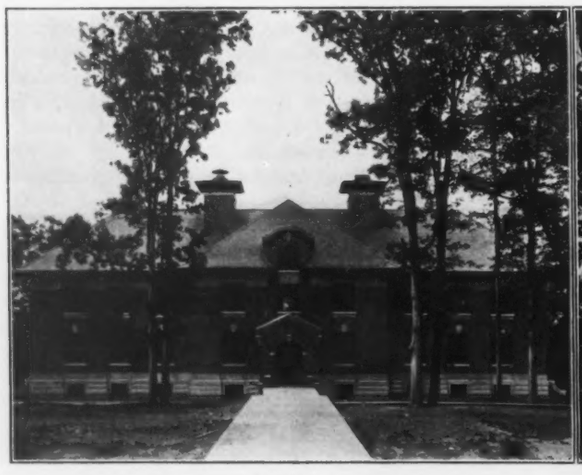


FIG. 1.—MECHANICAL LABORATORY.

FIG. 3.—PHYSICAL LABORATORY.

WORK OF THE ELECTRICAL DIVISION.

The work of the Electrical Division of the bureau is divided into sections, as follows:

Section 1. Resistance and E. M. F.

The work of this section consists in the verification of re-

sistance standards and standards of e. m. f.; the calibration of precision rheostats, Wheatstone bridges, potentiometers and other resistance apparatus; the verification of resistance standards for current measurement; the determination of the electrical properties of materials, and researches on standards of resistance and e. m. f. Without giving space to the details of the routine of this section, or to the instrumental equipment for its work, which are given at some length in the paper already referred to, it may be stated briefly that high-precision methods are employed for the verification of original standards, and the calibration of secondary standards, and that any special researches are made that may be required, and that would be entirely beyond the facilities of any private laboratory, such, for example, as the thorough investigation on standard cells (both Clark and Weston) recently published in the *Bulletin* of the bureau.

Section 2. Inductance and Capacity, and Absolute Measurements.

The work on inductance and capacity includes the investigation of methods of measurement, the construction and testing of the bureau's standards, testing for the public, and the measurement of the inductances and capacities of instruments. The bureau possesses a series of standards of inductance and capacity, the values of which have been fixed with high precision using several different methods of measurement.

The testing of condensers includes not only the measurement of their capacity, but the investigation of the variation of the capacity with frequency or duration of charge, temperature, leakage and power-factor of the charging circuit, whereby their constants are completely ascertained, and they become instruments of precision. The calibrating of well-made inductances to 0.02 per cent is made a special feature of the work. Such standards are exceedingly useful in facilitating the making of accurate inductance measurements, which now play an important part in electrical measurements.

The equipment for measurement of capacity and inductance is very complete, and includes means for determining the residual capacities and inductances in the "non-inductive" coils of resistance boxes so as to permit their use with alternating currents in inductance measurements.

A number of important researches in absolute measurement have been completed and published in the *Bulletin*, including the ratio of the electromagnetic and electrostatic units; determinations of an absolute standard of inductance, the value of which is accurately known by calculation; the design and construction of a new type of chronograph, enabling accurate measurements to be made very quickly of the speed of a driving motor or the frequency of a current; the change in resistance of standard coils and resistance boxes due to atmospheric humidity; a new form of resistance standard; and the calculation of self and mutual inductance of coils of various forms. Other researches now in progress are: A study of the coulometer (volt-ammeter); the absolute measurement of current by means of an electro-dynamometer, and the absolute measurement of resistance by different methods. The results of several of these and other researches upon electrical subjects have already been published in the *Bulletins* of the bureau, and reprinted as "separates," which may be obtained upon written application to the bureau.

Section 3. Electrical Measuring Instruments, and Section 5, Photometry.

The work of Section 3 includes the investigation and testing of instruments of precision for measuring current, voltage and power (both direct and alternating); and the testing of laboratory and commercial instruments designed for such measurements, such as ammeters, voltmeters, wattmeters and watt-hour meters for direct and alternating currents, and special alternating-current instruments, such as frequency meters, phase meters, curve tracers, etc.

The photometric work of the bureau comprises the testing on incandescent-lamp standards for candle-power and distribution of light, the commercial testing of lamps as to life, candle-power and efficiency for various departments of the government, and the study of special problems in photometry. The equipment includes precision and integrating photometers for measuring mean spherical and mean hemispherical candle-powers, a Brace spectro-photometer, a flicker photometer, standard Hefner lamps, etc. A commercial photometer has been designed and constructed for the rapid testing of incandescent lamps. This instrument includes a horizontal and an end-on rotator, Bunsen screen with Leeson disk, and variable sectored disk, by the use of which lamps ranging from 5 to 100 candle-power can be read without readjustment of the standard lamp. An efficiency meter, by means of which efficiencies or watts per candle can be read directly, has recently been designed and built and added to this photometer.

In connection with the photometric work a number of researches have been made and published.

Section 4. Magnetism.

A considerable number of instruments for testing the permeability and hysteresis of specimens of iron have been secured and comparisons made by testing the same sample with different apparatus. Several important investigations have been made in magnetic measurements, and will shortly be published. The bureau is in a position not only to measure with commercial accuracy the permeability and hysteresis of specimens of iron and steel of various forms and under working conditions, but also to test specimens to a higher precision to be used by others in their own instruments as standards of comparison.

WHAT THE BUREAU CAN DO FOR THE ELECTRICAL ENGINEERING PUBLIC.

Having touched briefly on the resources of the bureau, we come to the services that it is in a position to render to the electrical engineer. Among the functions prescribed by the Act of Congress by which the office of Standards, Weights and Measures of the Treasury Department was, on July 1, 1901, superseded by the Bureau of Standards, were several which are stated briefly in *Bureau Circular No. 6*, dated Feb. 20, 1906, as follows: "The bureau will furnish such information concerning standards, methods of measurement, physical constants, and the properties of materials, as may be at its disposal, and is authorized to exercise its functions for the Government of the United States, for state or municipal governments within the United States, for scientific societies, educational institutions, firms, corporations, or individuals engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments. For all comparisons, calibrations, tests or investigations, except for those performed for the Government of the United States or state governments, a reasonable fee will be charged."

The range of tests made by the bureau—including verification of standards, determination of constants of apparatus and of electrical properties of materials and general testing work—and the fees charged for the same, are covered in detail in the circular to which reference has just been made. This circular also contains regulations covering the proper form of the application for tests, shipping directions, remittances, etc.

The above references cover some of the specified activities of the bureau, but some of the special ways in which the bureau stands ready to carry out its functions are, however, not so well known as they should be to engineers and the managements of central-station companies. The following brief account is intended to set forth these special services, in accordance with the desire of the director of the bureau and his official staff for a better and more general understanding of them. The wider usefulness of the bureau consists in the placing of the valuable scientific and technical resources of the government virtually at the disposal of the commercial and engineering public, as follows:

1. The bureau stands ready to test portable instruments, such as voltmeters, ammeters and wattmeters, used by the central station in checking other instruments. This testing ought to be done, not only at the time of purchase, as a check on the maker's calibration, but at intervals later, say, every six months,

to detect changes with time. The fees are nominal, and in many cases do not amount to the cost of doing the work.

2. When instruments or apparatus are sent in for calibration the bureau gives an impartial test, unaffected by any commercial considerations, or by the "personal equation" that comes in where the instrument is sent to its manufacturer for such calibration, or where an instrument made by one manufacturer is sent to the testing laboratory of another manufacturer for recalibration. Further, the bureau will point out any defects that may exist in the instrument for the work in hand, if requested to do so. Sometimes defective and inaccurate instruments are put out by manufacturers. If a customer returns such an instrument to the manufacturer for test and recalibration, it would ordinarily be returned to him without comment, whereas the bureau not only reports the observed accuracy of the instrument, but stands ready to advise in regard to its suitability or unsuitability to the work in hand.

3. If a central station company is contemplating the purchase of a number of instruments of a new or untried type, it can send in a sample, submitted by the manufacturer, for the government test before buying. Having bought the instruments, if the company has any reason to imagine that any of the shipments are not "up to standard," it can send in additional samples from each shipment, from time to time, which will be tested and reported upon. Of course, this applies particularly to electric service meters, of which a central station company purchases a considerable number. The same thing applies to indicating instruments and test meters for testing service meters at the consumers' installation, and to samples of service meters of different makes, to determine their comparative value and to provide standard meters to be used in checking others.

In the case of transformers, although the same plan might be followed, the bureau would encourage central station companies to make their own tests, especially as the expense of shipping transformers is comparatively heavy. The large electrical manufacturing companies issue instruction books which facilitate the testing of service transformers even by small central station companies that are not thoroughly well equipped with testing instruments. Central station companies are rarely equipped to test the current and potential transformers of instruments, however, and the bureau stands ready to perform this work for them.

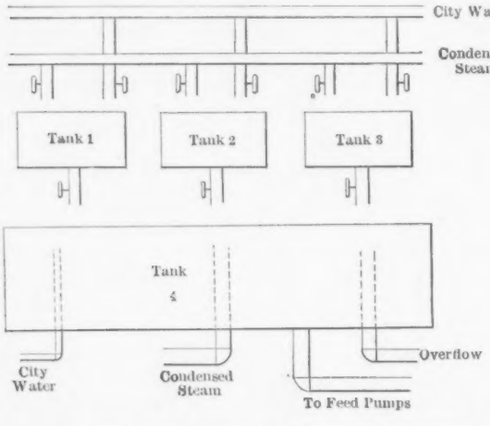


FIG. 1.—METHOD OF MEASURING FEED WATER.

4. The bureau is useful to central station companies in an indirect way by serving as a sort of court of appeal in disputes with customers over meter charges. The mere statement of the fact that the company "has its instruments and meters tested by the government" may often avail to terminate an otherwise vexatious dispute.

5. The bureau invites the representatives of companies' managements contemplating the organization of a new equipment or changes in old equipment, to call at the bureau and consult with the experts. This applies especially to the organization of a testing department or meter department, where none already exists. The bureau is especially ready to give information and suggestions to stations contemplating the testing of incandescent lamps or transformers, as to the best methods and apparatus for such work, and to test incandescent lamps to be used as standards of candle-power. Such consultations are well worth while and will often save many times over the time and expense involved by the saving of unwise or unnecessary outlay and by suggestions for the general improvement of the plant that are brought out by the consultation.

In addition to the regular lines of work referred to above, the bureau is prepared to undertake a certain amount of research work along special lines that is beyond the facilities of even the very large central station companies.

Test of Medium Capacity Central Station.

By Howard S. Knowlton.

In the following paragraphs are given the results of a test recently made upon a central station of about 2500 kilowatts normal capacity. As the test was of a semi-private nature, the name of the plant is omitted, but it is thought that the methods employed and the results obtained may be suggestive to companies interested in testing stations of about this size. The objects of the tests were to investigate the operation of the plant as a whole when running under ordinary commercial loads, and to determine the steam consumption and thermal efficiency of a 1000-kw Westinghouse turbo-alternator.

The plant is located in New England near the shore of a large river which supplies condensing water and permits the handling of coal by water. Coal is received in barges, from which it is unloaded by an elevator and stored in a yard, whence it is conveyed by tracks to a crusher. The latter is driven by a 15-hp Westinghouse induction motor. The coal is then lifted to a pocket in the top of the boiler room by an endless chain elevator, also driven by this motor. It is then distributed in the bunker by an 18-in. belt conveyor. In the bottom of the bunker are three gates operated from the floor, through which the coal falls into a weighing car. This car is provided with weighing scales and a chute, which delivers directly into the stoker receivers. The stokers are three Roney units driven by a 5-hp induction motor. The ashes are dumped in the yards from wheelbarrows.

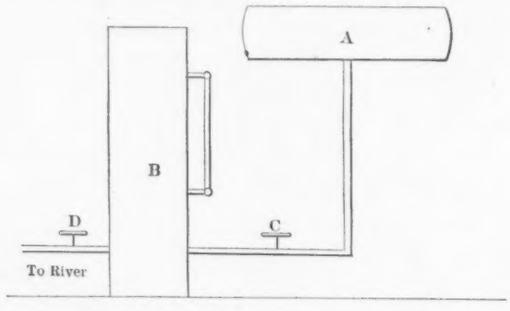


FIG. 2.—METHOD OF MEASURING DRIPS.

Three 650-hp Cahall boilers and a Sturtevant economizer are installed in the plant, the tube scraper being driven by a 3-hp motor. At the time of the tests a forced draft system was in operation, but this was to be changed to an induced draft outfit expected to give better results with the stokers. Feed water is supplied by one of the two Blake pumps, which draw from a main-feed water tank and discharge through a primary heater and the economizer into the boilers. The primary heater is located in the pump room and is furnished with the exhaust steam from the turbine and reciprocating engine auxiliaries. Wet vacuum pumps, situated beneath the turbine condensers, deliver the condensed steam to the feed-water tank, and the make-up water is supplied automatically from the city mains. Two steam mains, with cross-connections, run from the boilers to the prime movers. One main is connected to the boiler

superheaters and leads to the turbines above, while the other is used for saturated steam and is tapped by both reciprocating engines and turbines. The latter may be driven by either superheated or saturated steam.

The main generating units consist of two 1000-kw three-phase turbo-alternators. The reciprocating engines supply from 435 kilowatts to 935 kilowatts in 500-volt direct-current power, there being two engines of the compound condensing type for this work. The station outfit is used for incandescent and lighting, railway and power service. The maximum alternating-current load is about 1000 kilowatts, so that one machine easily handles it. During the past winter the peak load was about 1200 kilowatts. Two 50-kw exciters are provided. The turbine exhaust is handled by Worthington surface condensers of 4500 sq. ft. cooling surface. Cooling water comes from the river. A carbon-dioxide recorder is used in the plant, and the station is equipped with two Tirrill regulators.

The scope of the tests covered the following points: 1. A seven-hour test on the plant as a whole under ordinary working conditions, covering both maximum and minimum loads. 2. Special tests under specified loads on one turbo-alternator, with loads varied in 25 per cent stages from 25 per cent to 150 per cent of the rated output. The power generated in these tests was consumed in water rheostats. 3. Individual tests on auxiliary apparatus to determine their steam consumption and its relation to the total.

The position of observers, their apparatus and duties for the 72-hour test were as follows:

Station 1.—Coal. One man was required at this station, which was located on a platform above the boilers. His duties were to weigh and record the amount of coal used, and the time of feeding to the stokers. Coal was weighed on calibrated scales provided before it was dumped into the stokers by the firemen. The man at Station 1 also recorded boiler-room temperatures from thermometer readings. Samples of coal were taken hourly and mixed in a box for subsequent analysis.

Station 2.—Feed-Water. The measuring tanks provided were lined with galvanized iron to prevent leakage, and calibrated previous to the test. A small barrel and platform scales were carried up to the tank platform. Each tank was filled to a certain reference mark and the amount of water weighed. During the test the tanks were filled to their reference marks and the number of fillings recorded, and also the time of feeding to the boilers. The drip, which is usually returned to the boilers by a Holly loop, was piped to a measuring tank, and quantities and temperatures recorded. The temperature of the feed-water was taken by a thermometer in the large tank into which the measuring tanks discharge. One man was required at this station. His duties were to record the number of tanks of water used, the time of emptying and the temperature of the water. The test was started with the water at a marked level in the feed-water tank, and one of the measuring tanks full. The level of the water in the boilers was marked on the water gages and measured. At the end of the test the water in the feed tank and in the boilers was brought as nearly as possible to the previous levels. The apparatus for this station consisted of thermometer, tank and scales for calibrating the measuring tanks.

Station 3.—Ashes. One man was required below the boiler platform to weigh the ashes as they were delivered from the boilers. Ashes were taken out in a wheelbarrow and weighed on platform scales. The man at this station also recorded the outside temperature. The test was started with the ashes all removed. The apparatus consisted of thermometer and platform scales.

Station 4.—Calorimeter. A Peabody throttling calorimeter was placed at the entrance of the delivery pipe to the turbine. The man at this station took readings every hour and determined the quality of steam after each reading. The apparatus was a calorimeter, two gages, high-scale thermometer and aneroid barometer. The records of this station gave boiler and atmospheric pressure, as well as steam quality.

Station 5.—Flue-Gas Analysis. One man was located at the point where the up-take enters the stack. He took and analyzed samples of flue gas every hour, and recorded the reading of the draft gage and stack thermometer. The apparatus consisted of an Orsat gas equipment with gas receptacle for drawing a continuous sample, chemicals, and high-scale thermometer. The draft gage was already installed.

Station 6.—Switchboard. One man at the switchboard read all instruments. These were direct-current wattmeter output, alternating-current wattmeter output, alternating-current wattmeter input to three auxiliary motors, and alternating-current wattmeter input to exciter. Readings were taken every 15 minutes. Alternating-current and direct-current main wattmeters were also read for total output every quarter hour.

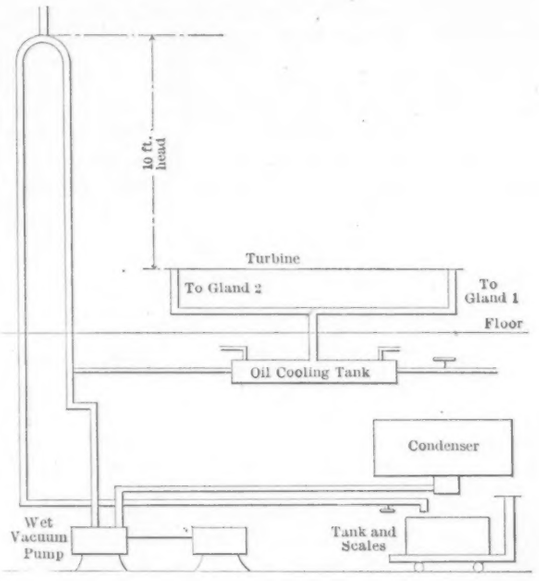


FIG. 3.—METHOD OF MAINTAINING WATER IN GLAND.

The individual turbine test was made with saturated steam. One man took calorimeter readings at the turbine. At the turbine one man recorded steam pressure, vacuum and speed by counter attached to the governor shaft, reading every 15 minutes. He also recorded temperatures by the thermometer at different parts of the generator and read the output of the machine and the input to the motor-driven exciter. Condensed steam was piped to two weighing tanks. The man at this station recorded the temperature of the cooling water before entering and after leaving the condenser, and the temperature of the condensed steam. The apparatus consisted of two tanks, two platform scales and three thermometers. Three men were required behind the switchboard. One attended to the water supply for the rheostats and the other two kept the load balanced and adjusted. A man at the switchboard recorded the readings of three ammeters, two wattmeters (one for each of the two phases) and one voltmeter. Two-hour runs were made at each point of fractional load.

The test for steam consumption of auxiliaries was run for 12 hours. The exhaust from all of these was piped to one condenser and the condensation weighed in three tanks. The station output was read on the two main wattmeters.

The water rheostats were two in number, of approximately 1800-kw capacity, placed in the power station yard just outside the transformer room and connected with the station by standard cables led out from the busbars through holes bored above the windows in the wall at that end of the room. The six terminals were supported by scaffolding erected above the rheostats, and the height of the plates was regulated by ropes and pulleys. Six faucets were also provided to supply cooling water as needed. In the station transformer room, on a platform, were three 120 to 1 ratio current transformers, and 20 to 1 potential transformers, through which the cables passed

before going to the rheostats. The secondaries were grounded as a precaution in case the insulation should break down. On a temporary table lower down were the ammeters, wattmeters and voltmeter, together with a speaking tube connecting with the rheostat man. The power consumption of the alternator field was measured, and speeds and steam quality taken. Some little difficulty was experienced in keeping the water rheostats cool at 25 and 50 per cent overload, but these temporary variations did not affect the results as the first hour of each test was spent in regulating the load and letting it attain a stable condition, and instrument readings were taken every five minutes of the second hour.

In the turbine test, calorimeter readings were taken every 10 minutes. The water of condensation was allowed to flow into one tank for a set interval of time and then into the other for a like interval. In the meantime the first tank was weighed and emptied. At the higher loads this time interval was about 1.5

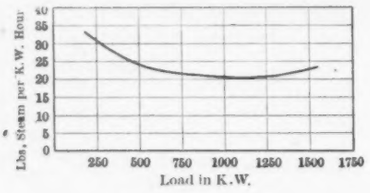


FIG. 4.—TEST CURVE.

minutes. The test for 50 per cent overload had to be discontinued after a run of one and three-quarter hours, as the two boilers, even when running with forced draft, could not maintain the pressure, which dropped as low as 110 lb. per inch. Readings were obtained for a full hour, however, because the recording of data was begun half an hour sooner than in the other tests.

A test on the mechanical stokers was made to investigate the operation of the stokers and of the entire boiler equipment at higher loads on the station than are customary. This was done during the turbine test when the load on the turbine was at normal, 25 and 50 per cent overload. The plan was to reproduce the starting conditions as nearly as possible at the end of each hour with reference to the height of water in the gage glasses and the amount of coal on the fires. The hopper was kept ever full throughout the tests. To do away with measurements of siftings throughout the grates, the ash pits and floor were cleaned just before the end of each hour. One man weighed the coal and measured the furnace drafts. A second man measured the feed-water, and a third the station output. Another kept the conditions constant and took the feed-water temperatures, boiler pressure and draft in the stack.

One turbine is always in operation at the plant, and with the present load both are not required at the same time. One of the reciprocating engines, with its corresponding belted generator, takes care of the direct-current motor load from 6 a. m. to 6:15 p. m. on week days, after which time a motor-generator set handles it. On Saturdays this set is started at 4 p. m. and run through until Monday morning, because of the light power demand on Sundays. Two motor-driven Brush arc generators are started about dusk and run until daybreak. The total power generated is thus exclusively alternating current at night.

The method of measuring the amount of feed-water supplied to the boilers is illustrated in Fig. 1. In this scheme, the tanks 1, 2 and 3 fed into a fourth tank, from which the feed pumps drew their supply of water. Above tanks 1, 2 and 3 ran two parallel pipes, one leading to the condensing systems and the other to the city water mains, so that each tank could be filled from either source of supply independently of the other tanks. When the plant is running under ordinary conditions, all of the condensed steam is pumped directly into tank 4. For the make-up supply, water from the city mains is admitted to tank 4 by means of an automatic valve and float arrangement which keeps the water-level constant. During the test, it was necessary for the operator to use his judgment about the amount of make-up water needed, as the feed-water was deflected through tanks 1, 2 and 3.

Fig. 2 shows the method of measuring the drip. The Holly return system collects the condensation from all the steam piping and automatically returns it to the boiler at boiler pressure. To determine the amount of this drip during the test, it was necessary to devise some method of measuring the water under high pressure. This was accomplished as in Fig. 2. The pipe leading from the collecting tank, *A*, of the Holly system to the boiler was closed by a valve (not shown in diagram), thereby preventing the condensed steam from returning to the boiler. On the bottom of the collecting tank, *A*, was inserted a 1-in. pipe, and to this was joined a plate-iron drip can, *B*, with a valve, *C*, in the connecting pipe. A 2-in. pipe containing valve *D* was inserted into tank *B* near the bottom to afford a passage for the drip to be blown into the river. Tank *B* was located below the level of *A* in order to allow the condensation to collect when valve *C* was opened and *D* closed, A 3-ft. gage glass on tank *B* permitted the operator to see the exact height of the water. The drip was allowed to collect until a certain level was reached, as indicated by a reference mark near the top of the gage glass. Valve *C* was then closed and *D* opened, thus allowing the drip to be blown into the river by its own pressure. When the level of the water had reached a certain reference mark on the lower portion of the glass tube, valve *B* was again closed and *C* opened. The time of each drainage was recorded and tank *B* was subsequently calibrated between the two reference marks. Hence, the total amount of drip, as well as the rate of collecting the same, could be determined.

For flue gas analysis a siphon arrangement was connected with the flue between the economizer and stack, so as to collect continuous samples of gas for hour periods. For a considerable portion of the test this method indicated very poor combustion in the furnaces, and upon examination it was observed that a large number of crevices in the economizer and backs of the furnaces admitted so much outside air as to completely vitiate the results of the flue gas analyses previously made. To overcome this difficulty samples were after this taken directly as the gas left the furnaces, and this method gave better results.

In a Westinghouse-Parsons turbine steam leakage through the seamings is prevented by means of water glands. To efficiently maintain the water in the gland it is necessary to apply a certain head on the gland water. Usually under normal running conditions this is accomplished by means of a small steam pump which supplies filtered river water to a standpipe. Some of the water may either leak through the gland and find its way to the condenser, or the steam may condense in trying to pass through the gland. In either case an error results in determining the steam used by the turbine. To eliminate this source of error in the turbine tests, the following course was pursued. Referring to Fig. 3, the oil-cooling tank through which the gland water ordinarily passes was cut off from the pump by means of the valve shown in the diagram. A 10-ft. head was placed on the gland so as to act through the cooling tank. The standpipe giving the 10-ft. head was in the shape of an inverted U, and was opened to the air at the top. One end of the standpipe was connected with the wet vacuum pump, and the other emptied into the tank arranged for weighing condensed steam. The receiver was emptied as usual by the wet vacuum pump. This enabled the gland system to be kept filled with water throughout a test, so that all water passing into the tanks was supplied by the condensed steam, and any leakage through the gland into the condenser simply circulated through the gland system and oil tank without affecting the amount of condensed steam.

The coal determination showed a calorific power of 12,995 thermal units (British) per pound in one sample, and 13,830 units in the second sample (stoker test).

The flue gas analysis showed the following average for gases taken from the stack and boiler setting in the 72-hour plant test:

Temperature	CO_2	CO	O_2	N	
237.5° F.....	5.51	1.09	13.75	80.65	Chimney
....	8.03	.23	11.22	80.52	Boiler setting

The difference in the percentage of CO_2 shows the effect of leakage in the boiler setting, the gas passing up the chimney being diluted with air. The heat loss in the chimney was 10.9 per cent. The total drip in 72 hours was 15,700 lb. The thermal efficiency of the plant was as follows, in the 72-hour run:

Total coal burned	132,567 lb.
Total power generated	33,940 kw-hrs.
Average coal per hour	1,841 lb.
Average power generated	471.4 kw
Average coal per kw-hr	3.91 lb.
B.T.U. per kw per minute (by analysis)	846
B.T.U. per hp per minute	631.2
1 hp theoretically equals per minute in B.T.U.	42.42
Efficiency of plant (42.42 ÷ 631.2) x 100	6.72 per cent
Maximum load in kw	1,157.3
Load factor	40.8 per cent
Average station lighting load in 72 hrs.	9.43 kw
Average exciter input in 72 hrs.	10.84 kw
Average auxiliary motor input in 72 hrs.	3.02 kw
Total direct-current output in 72 hrs.	7,330 kw-hr.
Average direct-current load	101.8 kw
Total alternating-current power generated, Turbine 1	19,600 kw-hr.
Total alternating-current power generated, Turbine 2	7,610 kw-hr.
Average alternating-current turbine load in kw	378
Total water fed	1,579,773 lb.
Test of Turbine Auxiliaries, 4-hour run:	
Steam consumption per hour	1,752 lbs.
Average power in kw	225

This includes the following pumps: One dry vacuum, one wet vacuum, one circulating and one gland water pump.

The results of the turbine test at various loads are given in the following tables:

	Load in kw					
	264	513	748	987	1275	1500
Steam per hour in lbs.	7,878	12,476	16,200	20,525	26,755	33,383
Steam per kw-hr. in lbs.	29.8	24.3	21.65	20.8	20.95	22.2
Vacuum in ins.	28.28	28.29	28.19	28.39	28.39	27.63
Field input in kw	3.07	3.29	3.55	3.92	4.35	4.80
Boiler pressure, lbs. absolute.	170.7	165.5	165.8	167.3	167.4	167.1
Temp. of cond. steam deg. F	52	54	56	63	81	81
Thermal effcy. in per cent.	9.83	12.05	13.57	14.25	13.77	13.51

The thermal efficiency, assuming dry coal, was:

B.T.U. input per pound of coal	13,830 B.T.U.
Water evaporated per pound of coal from and at 212 deg.	9.25 lb.
Heat taken in primary heater per lb. coal	1,056 B.T.U.
Heat taken in economizer per lb. coal	470 B.T.U.
Heat taken in boiler per lb. coal	8,705 B.T.U.
Thermal efficiency of boiler	62.9 per cent
Thermal efficiency of boiler with economizer	66.4 per cent

The generator showed a voltage regulation of 12.28 per cent when 1000 kilowatts non-inductive load were thrown off the machine. During this operation the frequency rose from 58 to 61.1 and the speed from 1765 r. p. m. to 1872 r. p. m.

In the stoker test, the average draft in the chimney was 0.74 in.; under grates, .43 in., and in furnace, .19 in. The average temperature of the feed water entering the boiler was 101.3 deg. C., and the average boiler pressure, 146.8 lb.

Direct-Current Motors, Their Action and Control—VI.

By F. B. Crocker and M. Arendt.

In the preceding article it was explained that speed control by variation of field flux is applied in practice to three types of motor, as follows: (a) magnetic circuit unsaturated, in which the flux is nearly proportional to the ampere-turns and the armature winding, as well as commutator, has many sections to diminish self-induction; (b) specially designed field magnets, in which the flux density at the pole-tips is always high; (c) a commutation field is maintained by a compensating winding or is established by auxiliary poles, commonly called "interpoles."

Bullock Motor.

Machines of Class (*a*) are built by many manufacturers, and while in successful operation they are larger than constant-speed motors, as already shown. The following data apply to a 5-hp, 3-to-1 variable-speed Bullock motor, and Figs. 1, 2, 3 and 4 are respectively magnetization, speed-load, flux distribution and efficiency curves at various field strengths, showing clearly the operation of this motor.

Data of Bullock variable-speed motor.

Rated capacity, 5 horse-power.

Rated pressure, 220 volts.

Speed, 350 to 1050 r.p.m.

Armature current at rated load 22.2 to 24.6 amperes (depending upon the speed).

Field current, 1.3 to .23 amperes.

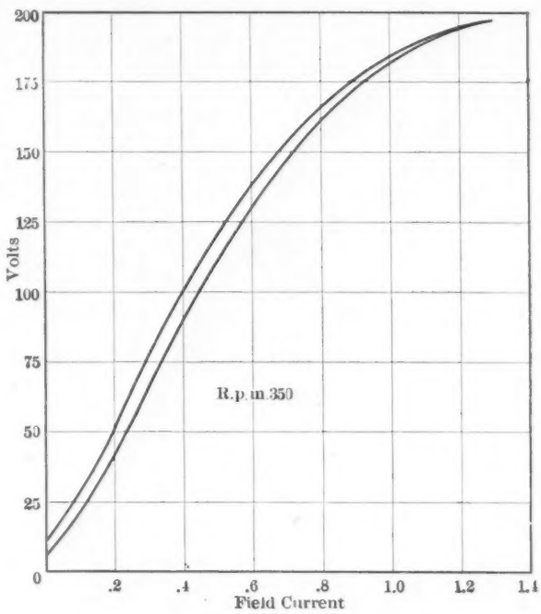


FIG. 1.—MAGNETIZATION CURVE OF MOTOR.

No-load armature current, 2.1 to 3.6 amperes (depending upon field strength and speed).

Armature resistance, hot, 1.12 ohms.

Field resistance, hot, 195 ohms.

Weight of motor complete, 1100 lb.

Storey Motor.

Machines of Class (*b*) were formerly manufactured by

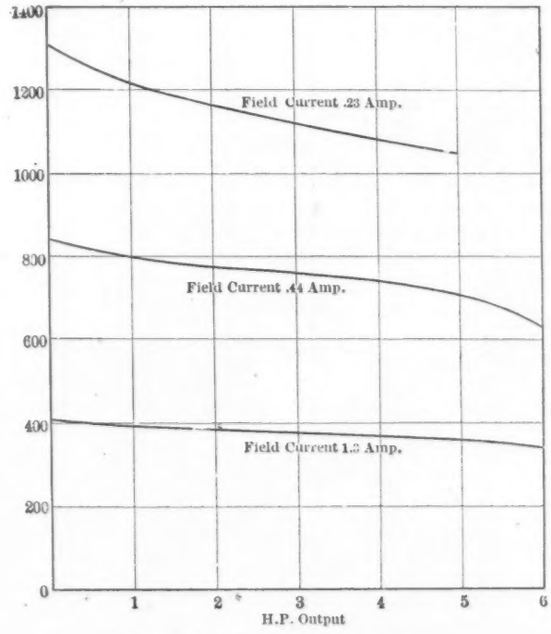


FIG. 2.—SPEED-LOAD CURVES OF MOTOR.

the Magneto Electric Company, and called Storey motors after their designer. The concentration and holding of the flux at the pole tips were obtained by recessing the pole pieces as shown in Fig. 5. In addition the steel of the frame was soft and flux density high, without reaching the bend of the magnetiza-

tion curve; the pole pieces are relatively short and the armature has many sections. A magnetization curve of a 3-hp, 3-to-1 speed motor of this type is shown in Fig. 6. Flux distribution

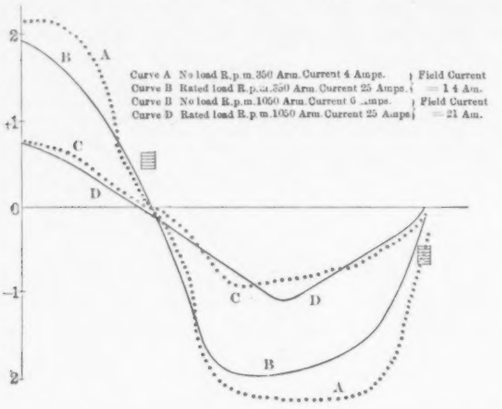

Curve A No load R.p.m. 350 Arm. Current 4 Amps. } Field Current
Curve B Rated load R.p.m. 350 Arm. Current 25 Amps. } = 1.4 Am.
Curve B No load R.p.m. 1050 Arm. Current 6 Amps. } Field Current
Curve D Rated load R.p.m. 1050 Arm. Current 25 Amps } = 21 Am.

FIG. 3.—FLUX DISTRIBUTION OF BULLOCK MOTOR.

curves at various loads and speeds are shown in Fig. 7. Speed and load curves are given in Fig. 8, and efficiency curves at various field strengths in Fig. 9. The data of one of these motors are as follows:

3-hp adjustable-speed (3-to-1 ratio) Storey motor.

Rated pressure, 115 volts.

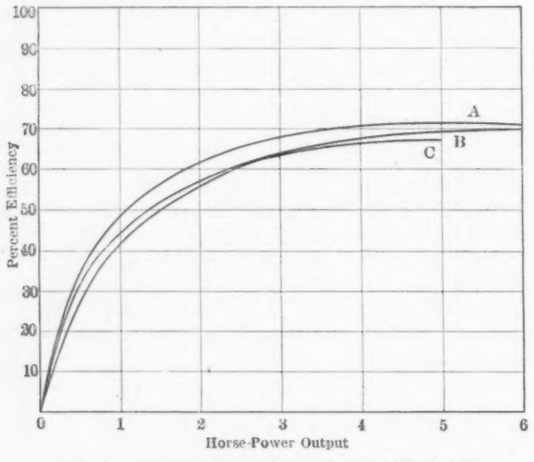


FIG. 4.—EFFICIENCY CURVES OF BULLOCK MOTOR.

Armature current at rated load, 25 to 28 amperes, depending upon the speed.

Field current, .5 min., 1.7 max.

No-load armature current, 1.1 to 4 amperes, depending upon the speed.

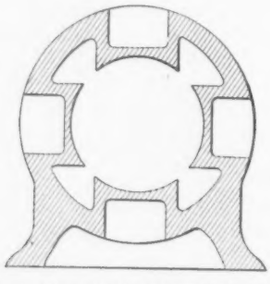


FIG. 5.—FIELD FRAME CONSTRUCTION OF STOREY MOTOR.

Armature resistance, .31 ohm.

Field resistance, 67.5 ohms.

Speed, 430 to 1290 r.p.m.

Weight, 800 lbs.

Interpole Motor.

A prominent type of adjustable-speed, direct-current motor embodying auxiliary commutation fields is that of the Electro-Dynamic Company.* It employs auxiliary poles located directly over the armature coils undergoing commutation, which poles are excited by a winding in series with the armature. Thus a flux

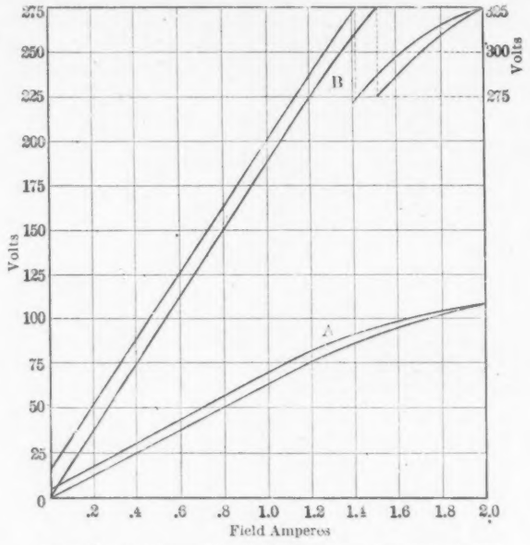


FIG. 6.—MAGNETIZATION CURVE OF STOREY MOTOR.

for reversal is obtained where needed, and at the same time it is one which increases with the load. The flux of these interpoles is in direct opposition to and slightly in excess of that

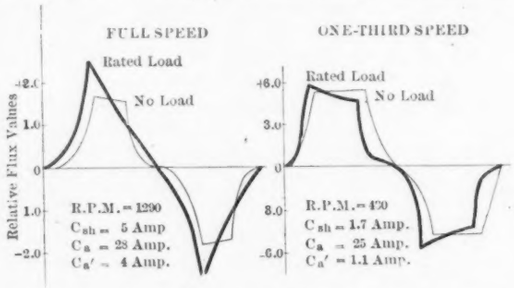


FIG. 7.—FLUX DISTRIBUTION CURVES OF STOREY MOTOR.

produced by the armature ampere-turns, the exact amount depending upon the length of the air-gap and quality of the iron

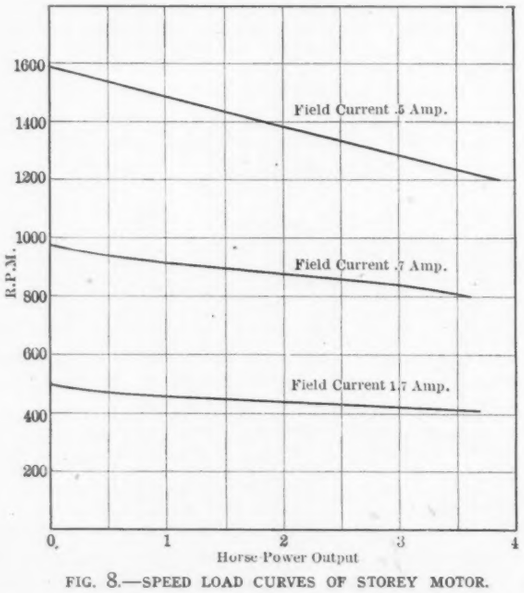


FIG. 8.—SPEED LOAD CURVES OF STOREY MOTOR.

employed; while the proper position for the brushes is such that no torque is produced by the auxiliary flux. The connec-

*U. S. Patent No. 775,310, Nov. 22, 1904.

tions of this interpolar motor are shown in Fig. 10, and data of a 5-hp, 6-to-1 variable-speed machine are as follows:

Armature current, 24 amperes max., 22.2 amperes min.
Field current, .16 ampere min., 1.27 amperes max.
No-load armature current, 1.7 max., .7 min.
Resistance of armature winding, 1.16 ohms.

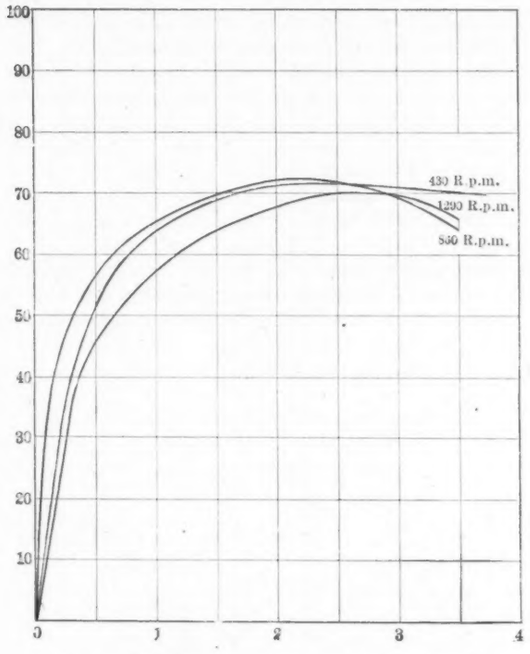


FIG. 9.—EFFICIENCY CURVES OF STOREY MOTOR.

Resistance of interpolar windings, .2 ohm.
Resistance of shunt field, 176 ohms.
R. P. M., 210-1260.
Weight, 1200 lb.
Speed, 210 to 1260 r.p.m.

The various working curves, such as magnetization, speed and load, flux distribution and efficiency are shown in Figs. 11, 12, 13, 14 and 15, respectively. The peculiar shape of the flux curves is due to the field of the interpoles producing a flux for reversal directly at the brushes. If the brushes be displaced so that the short-circuited armature coils are not directly under the center of the interpoles, the motor characteristics are considerably altered. The machine speed falls off considerably when the brushes are advanced, and increases when shifted back, thus resembling compound and differential motors under load changes. Hence to be equally

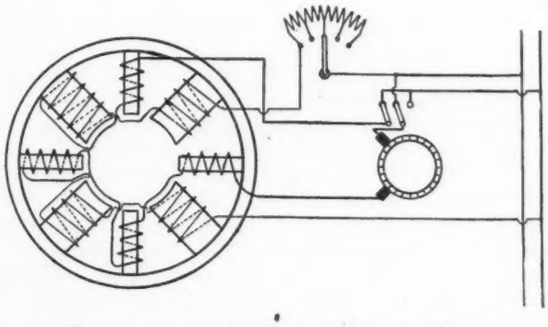


FIG. 10.—CONNECTIONS OF INTERPOLE MOTOR.

operative in both directions of rotation, the coil which is being commutated must be directly under the center of the interpole; this adjustment is shown in Figs. 13 and 14.

A study of these various curves brings out the difference in operation of the variable-speed motors of types A, B and C, respectively.

Dunn Method.

Another type of motor, the speed of which is adjustable by varying field flux, was invented by Mr. Gano S. Dunn.* The armature is supplied with constant current and the field wind-

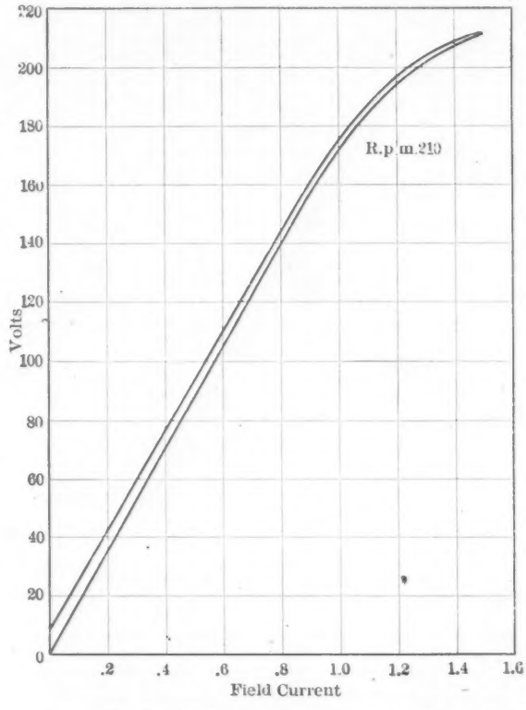


FIG. 11.—MAGNETIZATION CURVE OF INTERPOLE MOTOR.

ing separately excited from a constant-potential circuit through a rheostat. The armature current being constant, the torque varies directly with field flux. By means of the field rheostat this flux may be regulated from a very low value up to full strength with corresponding increase of torque. This large range of control is obtained by regulating the field current, which is small, the heavy armature current being kept constant by an automatically

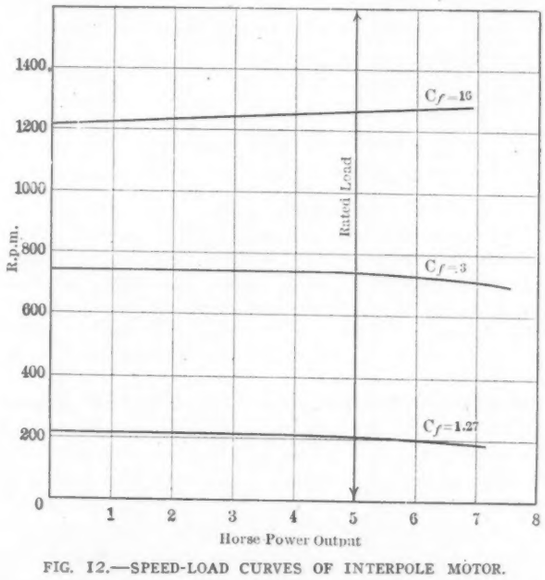


FIG. 12.—SPEED-LOAD CURVES OF INTERPOLE MOTOR.

regulated generator, as in constant-current arc lighting. The advantage is similar to that secured by the "field-weakening" method already described, but gives any torque or speed from zero to full value, while the latter is practically limited (unless special

*U. S. Patents No. 549,061, Oct. 29, 1895, and No. 591,345, Oct. 5, 1897.

designs are employed) to a certain ratio of speeds, usually 3 or 4 to 1. This method possesses an additional advantage over field-weakening control in having maximum field strength with maximum speed and torque. In these respects it would be adapted to adjustable speed work in machine shops. On the other hand, the necessity for constant-current as well as con-

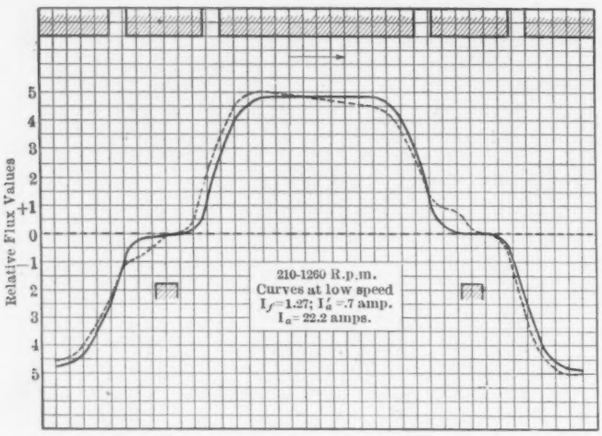


FIG. 13.—FLUX DISTRIBUTION OF INTERPOLE MOTOR.

stant-potential supply and the high voltage required to give any considerable power, are serious objections to this system. It is hardly practicable to operate motors below 20 horse-power with more than 100 amperes, at which current it would require about 1000 volts to supply 100 horse-power on one circuit—a dangerous

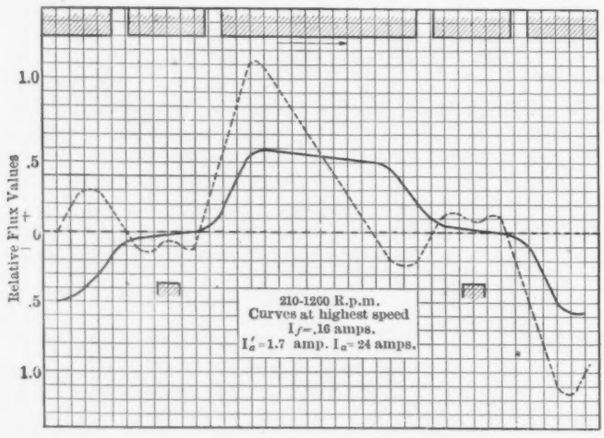


FIG. 14.—FLUX DISTRIBUTION OF INTERPOLE MOTOR.

voltage in a shop. To multiply circuits is objectionable because each would demand its separate constant-current generator. Furthermore, the latter has not been developed commercially above 10 amperes. For these reasons, the field-weakening and multiple-voltage methods are preferred for machine shop or similar service.

Combined Steam- and Gas-Engine Plant at Mankato, Minn.

The Mankato Gas & Electric Light Company has an interesting central station in which part of the units are driven by gas engines and part by steam engines. Originally the electrical end of the plant, which adjoins the gas works, consisted entirely of gas engines driving single-phase and monocyclic alternating-current generators. For the recent additions to the plant steam engines have been used.

It is interesting to note that apparently no trouble is experienced in throwing any of the generators in this plant in parallel, the generators driven by different gas engines and steam engines being run in parallel in regular operation without unusual precautions. These generators range in size from 50 kilowatts to 300 kilowatts. This experience is interesting in view of the fact that it is sometimes considered uncertain whether small single-phase generators driven by different engines can be operated in parallel without trouble in the ordinary small central station. The gas engines are Westinghouse three-cylinder, upright. Of the three gas engines now in the plant, one of 85 horse-power has not cost over $75 for maintenance in five years. Two engines of 125 horse-power, which have been in service five and three years, respectively, also have had a low maintenance expense, with the exception of one accident not to be charged to the engine. This accident was the knocking off of a cylinder head by accumulation of water in the cylinder while the engine was standing. The water leaked in from the water-jacket and the engineer failed to be sure that the cylinder was drained before attempting to start.

The gas required in actual daily operation averages 24 to 25 cu. ft. per kw-hour. The ordinary coal illuminating gas is used. This makes a tolerably expensive fuel. The economy could, of course, be considerably improved by installing a producer gas plant. The first cost and consequent investment

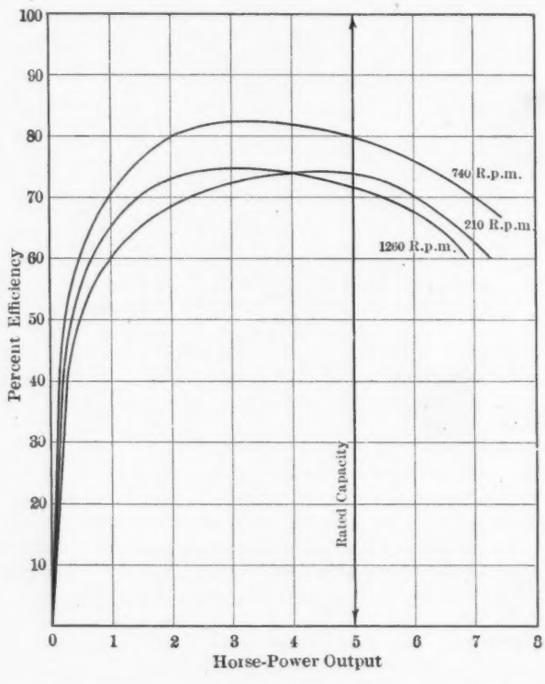


FIG. 15.—EFFICIENCY CURVES OF INTERPOLE MOTOR.

charges on such a plant have been found considerably higher than for steam.

At the time the last addition to the lighting plant was being considered, the question came up of whether to continue the station as a gas-engine plant or whether to install steam engines and boilers. As far as operating economy was concerned, the gas engine operating on illuminating gas and the steam engine operated with cheap Illinois and Iowa coals were about on a par. The cost of a 280-hp gas engine alone would have been about $12,000, or $57 per kilowatt. Besides this, it would have been necessary to enlarge the gas plant at an additional cost of about $10,000. Otherwise the gas plant would be sufficient for the gas service of the city for some time to come. The complete steam engine and boiler plant to operate a 300-kw generator were installed for $30 per kilowatt. The engines and boilers were then operated during the peak load, and the remainder of the 24 hours the gas engine carried the load. In this way the investment was kept down on the purely peak load apparatus, and the wastefulness of a steam plant operated at very light loads many hours per day was avoided.

Recently the situation has been still further changed by the building of a street railway in Mankato, for which the Mankato

Gas & Electric Light Company has a contract to supply power, and a Twin-City Corliss engine has been installed for driving the railway generator. It is an 18-in. x 36-in. simple engine running 120 r.p.m., direct-connected to a 200-kw, 500-volt, direct-current railway generator and belted to a 150-kw monocyclic alternator. This unit is to be run continuously during the day for railway and lighting loads, and the other gas and steam engines run on the peak. The last half of the night, when the cars are not running, the load will be carried by a gas engine. The connected motor load is about 200 horsepower. The day load on the station has been ordinarily handled heretofore by one 125-hp gas engine. The company is under the management of its secretary and treasurer, Mr. R. E. Brown.

Electric Light and Power at Greenfield, Mass.

GREENFIELD, Mass., the county seat of Franklin County, is a clean, thriving city of 11,000 inhabitants, the center of a truck-farming and tobacco-growing district, and has the largest tap and die manufactories in the world within its borders, the majority of the inhabitants being employed in these shops.

The first electric-light company was started in 1887 and was known as the Greenfield Electric Light & Power Company, with a capital of $5,000. The equipment consisted of a 50-light Thomson-Houston arc generator. A proposition was made to the gas company to run their generator in the gas company's plant to operate an incandescent lighting machine. This the gas company refused to do. Then a bargain was made with the owners of a large shoe shop by which the engine of the shoe shop ran the dynamo at night. In a year's time an engine was bought, and also two 200-light constant-potential generators, and inside lighting in Greenfield became an established fact. Business was done with the townspeople on the basis of a flat contract. The company was in active and open competition with the gas company. A representative of the electric-light company went through the city and asked the people what the amount of their gas bills were. Upon learning the amount, a proposition was made to furnish them electric lighting at the same price that they paid for gas, on a flat rate. This gave the electric light service a big start. Matters went along in this shape until 1894, when the capital of the company was increased to $30,000 and bonds were issued to the amount of $25,000. With this money a new station was built containing up-to-date machinery and meters were placed in service for the first time. The office of the company was then moved to the business center of the city, where larger quarters were obtained. The capital of the company has since been increased to $100,000, then to $130,000, and finally to $200,000. In 1902 the company bought a water-power site at Shelburne Falls, about nine miles above Greenfield, close to Buckland, Mass., where a large dam was built. The entire cost of the plant was $150,000.

The steam-plant equipment consists of three Hazelton upright boilers of 250 horse-power each. There is also one 600-hp Stirling boiler. The engines consist of one Russell 500 horse-power, one Buckeye 250 horse-power, and one Harris-Corliss 600 horse-power. The generators are four General Electric 400-kw, 2300-220-110-volt machines. There are also two 50-light luminous-arc outfits. The switchboard consists of eight panels. The coal for the station is brought by wagon and then wheeled to the boilers. The machines in the station are all belted. The ashes are used for filling in a swamp near the station. The peak load in winter registers 950 kilowatts and occurs between 5 and 6 p. m. In summer the peak occurs between 7 and 8 p. m. and registers 800 kilowatts.

The force required to operate the station is as follows: Superintendent, line foreman, six linemen, one foreman for inside wiring, an average of six inside wiremen, one chief engineer, three engineers, four firemen, two switchboard men and one laborer.

The lines are all overhead. The transformers are used individually on the lighting circuits, and grouped for power circuits where the load is heavy. The primary circuits have permanent ground detectors.

The power load is composed of 134 motors aggregating 810 horse-power. The largest single motor is a 60-hp machine driving a brick press. The power is furnished at 220 volts, three-phase, alternating. The total length of wire strung on the poles is 600,193 ft. The number of poles is 962. The total amount of energy generated last year was 1,877,916 kw-hours. The total number of incandescent lamps connected of all sizes of candle-power is 10,046. The company furnishes to the city 69 arc lamps at $87.50 per lamp per year. There are also 61 incandescent lamps of 40 candle-power supplied at $29 per lamp per year.

The meters are tested at the office of the company, where ample room has been given for their care. When the meters are received from the makers they are placed in stock without testing. All meters are tested regularly once a year, also cleaned and adjusted if found to be off standard. Upon complaints of high bills and requests made to have meters examined, the meters are tested in circuit, a portable testing set being used. The meters are read on regular days each month. There are about 600 meters on the circuits. It takes two men about four days to read them. The index books are of the loose-leaf type. When a new consumer is connected up and his meter is set, a card is made out and placed on file as the consumer's record of meter and installation. The information on the card calls for address and name of consumer, occupied as, service started, suspended, meter number, date removed, cause, amperes, volts, constant, size and whether direct current or alternating current, whether two or three wire, location, installation consists of, sockets wired and size of lamps, make of motors, horse-power, volts, phase, arcs, make, amperes, circuit, number type and make of fans, and a space for remarks. This card record is kept as accurately as possible.

The equipment of the water-power station at Shelburne Falls consists of two Stillwell-Bierce & Smith-Vaile wheels of a total horse-power of 1200. They drive two General Electric 400-kw, three-phase machines. The current is sent down nine miles to the steam station at 10,000 volts, transformed for distribution to 2300 volts and finally reduced to 220 and 110 volts. This plant operates about six months of the year, being shut down the other half of the year by ice in the winter and in the summer by low water. The plant is operated by two engineers and two assistants.

The office of the company is very attractive and up-to-date. It is located in the heart of the city just off the main street. There are two very large show windows in which is very neatly arranged an electrical display. All appliances are placed in the windows in season. For night display, the windows are well lighted. The show room occupies the largest space in the office. On one side is a large table on which are placed various electrical heating and cooking appliances, and so connected that quick demonstrations can be made when requested. The rest of the show room contains electrical fixtures and lamps. A person doing business with the company passes through the show space whether to pay a bill or lodge a complaint, and the display is so arranged that a person is bound to notice it. Prompt attention is paid to any one requesting information concerning any portion of the exhibit. The rear portion of the office contains the meter room and stock room. The power bill is on buff-colored paper and the incandescent bill on blue. The consumers' ledger is of the loose-leaf type.

The new business is taken care of by one man, who spends all his time at it. He is paid a straight salary and takes care of both power and light. The results from his work are very satisfactory to the company. The entire field has been gone over thoroughly and all prospects kept track of. The solicitor was started on a flat-iron campaign with the result that in one year and a half of work, in conjunction with his other business, 156 flat irons were put out and are in daily use. The solicitor in this work carried a sample iron with him. It was found that when he was sent out to canvass for the installa-

tion of residence service that the electric flat-iron did good work as an entering wedge. The solicitor also sold Gem lamps and electric fixtures, although the greatest amount of sales are made at the office show room. The company furnishes free lamp renewals, the consumer purchasing the first installation. The solicitor has been for a short time at work building up a heating load. Already quite a few hair-curling irons and hot-water appliances have been placed. The electric sign, or, in fact, any sign extending out over the sidewalk, is not permitted by the authorities in Greenfield. There are one or two electric signs, but these are small affairs, both in size and electric equipment. The stores are closed every evening in the week with the exception of Monday and Saturday evenings, when they are kept open until 10 p. m.

The company does considerable advertising and has followed this up consistently. This is usually in the form of small circulars, on the back of the monthly bills and in the newspapers. Every month there is sent out with each bill some small descriptive circular on some one appliance or attention is called to some phase of the electric service as supplied by the company. These have from time to time brought back requests for further information. The company runs an advertisement in each of the two weekly papers, changing them each week. No follow-up letters or circular letters have ever been sent out. The back of the incandescent and power bills each month contain under the heading of "Facts and Suggestions" statements and notes concerning the service, of which the following are examples:

"Electric power is cheaper, cleaner and quieter than any other power.—It is well to have a duplicate set of bearings on hand.—Purchase the new automatic oil switch, which will take care of the overload without fuses or injury to the motor.—A motor attached to ceiling or side of building utilizes no floor space.—Make your starting load as light as possible.—Thoroughly clean your motor once a week.—Electric light creates no odor of any kind, no smudge, dust or sediment to settle on the surroundings.—Try the electric-heating pad. It maintains a uniform and constant heat. It is superior to and is rapidly replacing the hot-water bag.—You can iron in any room of the house with an electric flat-iron. It saves you many a weary step from stove to board. You need but one iron to do your entire ironing. We should be pleased to furnish you one on 30 days' trial.—Ask our meter man to teach you how to read your meter and figure your bill. He will gladly do this."

The results from the advertising done have warranted the company in paying more attention to it. The company has not as yet been interfered with politically or otherwise in the pursuit of its business and has enjoyed since its commencement the confidence of the public.

The company has been progressive in the matter of rates for both power and light. When the meters were first installed a rate of 16 cents per kw-hour was made, with a 10 per cent discount if the bill was paid promptly. As the business of the company increased and in its efforts to get some of the larger of the gas consumers, all sorts of special rates were made. These were, after some difficulty, all abolished and the present rate put into operation. This rate footed up a reduction of 23 per cent over the old schedule and a saving of that amount to the consumers. The present lighting rate ranges from 15 cents to 8 cents per kw-hour according to the amount used. The incandescent rates are as follows:

Between	0	and	75	kw-hours	monthly	15	cents
"	75	"	100	"	"	14	"
"	100	"	200	"	"	13	"
"	200	"	300	"	"	12	"
"	300	"	400	"	"	11	"
"	400	"	500	"	"	10	"
"	500	"	600	"	"	9	"
	600 kw-hours and over at					8	"

A discount of 10 per cent is allowed if the bill is paid within 10 days of delivery of bill, on all bills in excess of $1.50 per month. There is a service or minimum charge of 41 cents per month on all lighting bills whose amount does not reach $1.50 per month. For example, if a consumer's bill was 50 cents for a month, 41 cents would be added, making the total bill 91 cents for that month.

The power rates are based on consumption, the basic rate being 6 cents per kw-hour. There is a minimum or service charge on all power bills for service up to and including three horse-power, of $1.50 per month. On an installation of more than 3 horse-power, the service charge is based at the rate of 50 cents per horse-power connected. There is no discount allowed for prompt payment as on the lighting rates. The power rates are as follows:

Between	0	and	100	kw-hours	per month	6	cents
"	100	"	200	"	"	5.5	"
"	200	"	400	"	"	5	"
"	400	"	600	"	"	4.5	"
"	600	"	800	"	"	4	"
"	800	"	1,000	"	"	3.8	"
"	1,000	"	1,200	"	"	3.5	"
"	1,200	"	1,500	"	"	3.2	"
"	1,500	"	2,000	"	"	3	"
"	2,000	"	2,500	"	"	2.7	"
"	2,500	"	3,000	"	"	2.5	"
"	3,000	"	4,000	"	"	2.3	"
"	4,000	"	5,000	"	"	2.2	"
"	5,000	"	6,000	"	"	2.1	"
"	6,000	"	8,000	"	"	2	"
"	8,000	"	10,000	"	"	1.9	"
"	10,000	"	over	"	"	1.8	"

Mr. J. W. Stevens, the president of the company, stated in regard to the work that had been accomplished: "We were very fortunate in having in Greenfield a city that is clean, politically and otherwise, so that our start in the electric light and power business was a favorable one, not being hampered by various obstacles placed for personal or political gain. We did our level best to interest the gas company, as did a great many of the private citizens, in the production of electric current, but to no avail, so that our only alternative was to go ahead and produce current the best way we could. The changing over from a straight flat rate to one of metered charges brought us a great deal of trouble, which was amicably settled. Perhaps it is safe to say that the meter rates when first put in operation increased the monthly bills of many customers. But, on the other hand, among the arguments presented to our customers was the fact that the new and up-to-date machinery installed was giving them a service much above the old and also that they were paying at a fairer rate, both for themselves and also for the company. We, like every other electric company, began from that time on to reduce continually our rates, owing to the increase of business and the lessening of the production costs by the new machinery. These reductions at our present schedule amount to about 23 per cent on our first schedule.

"Our new-business work we have found to be worth keeping up. The result of our solicitor's work in this field we have found to be entirely satisfactory. As he not only keeps visiting the old consumers, but the prospective ones as well, we are kept in close and active touch with our customers and the solicitor has become an interesting source of knowledge to the company in personally learning the needs and wants of the consumers and for the consumers in learning of the aims of the company. Our advertising is another method of getting in closer touch with the consumers, as we have frequently found to our advantage. We have and are now adding a great amount of additional machinery, mostly generators. An up-to-date switchboard will be installed with all the latest appliances and instruments.

"We supply the street-railway system with current, and arrangements are now being made by which we expect to get a large share, if not all, of its business. We have a great many shops here in Greenfield, and we expect to get their power business. It will be a question of rates more than anything else, but we believe that we can arrange matters so that we can quote a low enough rate to get the business and make some money on the proposition. In the matter of signs, we have experienced some trouble in getting them installed owing to the ordinance prohibiting signs over the sidewalk. We have never made any effort to have the ordinance repealed. There are some places that have under consideration the matter of having electric signs placed against the building, but as the stores are only opened two evenings in the week, the storekeepers are rather skeptical of their utility.

We realize that Greenfield has only just tasted electric service and we are on the move to have it swallowed whole."

The officials of the Greenfield Electric Light & Power Company are: Mr. J. W. Stevens, president; Mr. Charles R. Keith, secretary; Mr. G. W. Lawrence, treasurer and superintendent; Mr. C. F. Mosher, chief engineer; Mr. H. D. Seavey, chief electrician.

Motor Ratings, Old and New.

By F. J. Chisholm.

The complaint is sometimes heard from motor buyers, "Motors are not as good to-day as they used to be," meaning that the overload capacity of the present motor is not as great as that of its predecessor. A word of explanation may be useful for a clear understanding of what changes have actually taken place.

Until a few years ago, when the fundamental patents covering induction-motor design expired, motors were generally guaranteed to carry 25 per cent overload for 24 hours, 50 per cent overload for two hours, and 100 per cent overload for half an hour without injury of any kind. The reason for these great overload capacities were several, of which the chief one was a lack of knowledge as to the horse-power required by machine tools.

Before the introduction of the electric motor, tool manufacturers could only test for power required by long and costly methods based upon steam indicator card readings. The fact that all shops were operated on the large-group-drive principle gave little necessity for knowing the individual rating of each tool. When, therefore, the electric motor came into use and a large group of machines was to be cut up into smaller groups, motor-driven, it was discovered that often no two groups gave the same result. A motor of a given rating would drive one group easily, and run very hot on a second group of apparently similar make-up as to number and type of tools and methods of working. Motor manufacturers were consequently driven to very liberal ratings, so that, if a motor did have an overload, the margin would be ample to carry it with safety. Purchasers were not long in learning that an electric motor was a machine which would stand much abuse as to overloads and grew to consider this as an inherent feature.

With the continued success of the motor as a driving machine, both tool manufacturers and makers of motors realized the necessity of knowing just what power each tool and appliance required. The electric motors themselves, with suitable measuring instruments, readily furnished the data hitherto almost unobtainable. When this information became known there was no longer any need for the extra liberal rating of motors. Accordingly the leading makers of motors offered to the buying public machines 25 per cent lower in cost than the older types of the same rating and lighter in weight for the same horse-power capacity.

Buyers were first attracted to the lowered prices of motors, but soon became confused in some cases when reports came back that "any old load" the attendant cared to put onto the machines could no longer be imposed without disastrous results. Competitive conditions prevented the manufacturing companies from starting a campaign of education before this change of ratings went into effect, and even to-day there is more or less confusion as to what changes were actually made.

Now the application of a given horse-power rating to a motor is a somewhat arbitrary affair, for the reason that a given amount of iron and copper worked up into a motor may be made to carry any load up to a point where the motor will go up in smoke. A mass of metal which would carry 20 horse-power for one minute before burning out, could not be offered to the public as a 20-hp motor, of course. Evidently the horse-power rating on the name-plate would have to be a safe fraction of this load. If, for instance, it were labeled 7½ horse-power, then a 25 per cent overload could be carried indefinitely and a 100 per cent overload for half an hour without injury. Assuming a weight of 1000 lb. for this mass of finished metal, and a cost of 50 cents per pound to manufacture, then the motor would sell for $500.

Suppose, however, this same mass of metal was called a 10-hp motor; we would now safely carry 25 per cent overload for only about two hours, 50 per cent for half an hour and 100 per cent overload momentarily. This new motor still weighing the same as before would be sold at $500. Of course, the buyer who had paid $750 for a 10-hp motor made from 1500 lb. of metal would now pay $500 for a motor rated at 10 horse-power.

Some buyers at first seemed to think the reduction in price should have been allowed for machines of the old ratings. But how they could reasonably expect manufacturers to use the same quality of material and labor and sell for 25 per cent less than before, in a rising market, is not clear. As a matter of fact, equivalent value was still offered. The change in ratings was somewhat modified by new designs which enabled manufacturers to obtain more horse-power from a given mass of metal.

The change in alternating-current motor ratings was soon followed by a like change in direct-current motors, and more conservative ratings are gradually coming out for generators, both alternating current and direct current. No mention has been made of heating as affecting ratings, because design affects this very much. Ventilating openings, fan blades, etc., all tend to make arbitrary the rating of a given weight of metal when manufactured into the finished machine.

Electric Light Lines Above Trees at Winchester, Ind.

Two years ago, at the suggestion of the Citizens' Water & Light Company, of Winchester, Ind., the City Council of that town passed an ordinance regulating the height of trees to 35 ft. The company promised to rebuild its lines complete if such an ordinance was passed. This was done, and Figs. 1, 2 and 3 show the general appearance of the shade trees and lines in winter as a result of this move. The company used 50-ft. poles. As can be seen from the engravings, the appearance of the street has been improved on the whole by this move, and the very serious difficulties encountered when trying to run

FIG. 1.—45-FT. TREES IN WINCHESTER STREET.

electric-light lines along heavily-shaded streets without objectionable trimming, are largely eliminated. The trees were trimmed by property owners before the lines were rebuilt in

FIG. 2.—LINES ABOVE TREES, WINCHESTER, IND.

accordance with the order of the City Council. The company has not had to trim the trees as yet, though presumably it could easily be done, as in some other cities, by the use of a cable

FIG. 3.—WINCHESTER STREET WITH HIGH LINES.

stretched between poles, on which a lineman could be sent out on a traveler. Mr. Carl R. Semans is manager of the company.

Development at Albert Lea, Minn.

The Albert Lea (Minn.) Light & Power Company is a notable example of a company which makes the most of its opportunities. This town is a railroad center in southern Minnesota, with a population of about 5600. The company has a direct-current plant operating at 110 and 220 volts, three-wire, with Corliss engines and also supplies an Evans-Almirall hot-water heating system giving service in the business district. The company also has a water-gas plant.

The electric earnings per capita for 1907 were $5.65. The hot-water heating earnings were $1.31, and the gas earnings $1.70. Of the electric earnings, $1.40 per capita was received for electric power and 55 cents for street lighting. From this it will be seen that the town is not liberal in its street lighting. The company has nearly all the power load in the town, except a 30-hp engine in a laundry; it has, however, 24 electric irons in that same laundry.

The electric customers number 650, divided as follows: Residence customers, 500; power, 75; store and office lighting, 75. The connected motor load is 400 horse-power, the largest motor being of 90 horse-power. One of the largest customers is a flour mill which operates 24 hours per day part of the year. The company also drives the factory of the American Gas Machine Company, a rapidly-growing gasoline lighting plant manufacturing works. This being the home town of this prosperous manufacturing company, a number of stores have gasoline lighting, since the company keeps its gasoline plants in first-class condition on account of the out-of-town prospective gasoline-plant purchasers, who naturally come to Albert Lea.

The rates for electric light are 12 cents per kw-hour net, with quantity discounts down to 8.5 cents. The power rates are 7.65 cents per kw-hour for small users. For large users they are 7.65 cents for the first 30 hours' use of the connected load and 5 cents for all above that. A solicitor is employed part of the year. As a part of the advertising and soliciting campaign, an office has been fitted up near the main street for which a rental of $25 per month is paid. Heretofore solicitors from out of town have been brought in, but this year a solicitor trained in the company's ranks will be used. The plan for the immediate future is to push for the kind of business which calls for no extension of lines. In the electric end, this will include electric heating, electric signs at flat rate, outline lighting and show-window lighting at flat rate. By taking show-window lighting at a flat rate, to be under control of the company, it is hoped to liven up the down-town district. The company's exhibit room is well illuminated with Gem lamps in bowl reflectors placed near the ceiling, thus furnishing a practical example of efficient and effective store lighting. Free renewals are furnished on both Gem and common carbon-filament lamps. The Gem lamp, with its accompanying reflectors, has proved very effective in meeting competition. These lamps have been placed in 12 saloons formerly using gasoline plants. These are on a flat rate and are turned off by the owners at 11:30, a check being kept on this by the company. This flat rate is the equivalent of about 8.5 cents per kw-hour. Last summer 60 electric irons were put out. There are now about 75 altogether in use.

POWER-STATION NOTES.

The power plant has direct-current generators driven by Corliss engines. The largest unit has a compound Corliss engine. The hot-water heating system connected is more than enough to take all the exhaust steam during the day. In the summer the engines are run condensing. They are also run partially condensing during peak load in the winter. This is done by passing the exhaust first through the hot-water heater and then to the condenser. The evening the writer visited the plant an 18-in. vacuum was being maintained. The heat needed over and above that supplied by the engines was supplied by live steam from the boilers. The object of running the engines condensing, even though live steam had to be supplied to make up the deficiency, is to get sufficient capacity out of the engine to carry the load. The output in 1906 was 750,000 kw-hours, which in 1907 increased to 825,543. The coal per kw-hour for all purposes in 1906 was 9.75 and in 1907, 8.9, including coal used in the hot-water heating system. The coal used in summer, when the heating system is not in operation, is 7.2 lb. per kw-hour.

The total coal used in 1907 cost only 1.5 per cent over 1906, although the output in kw-hours increased 10 per cent. This is a record of which the manager justly feels proud. The reduction has been made by constant vigilance, both in purchasing and using coal. Southern Illinois steam coal is used, as

this is found to cost less per kw-hour than the La Salle lump formerly used. The coal is purchased on the b.t.u. basis, a contract being made with the Fuel Engineering Company, of Chicago, for sampling and testing the coal purchased. A small portable Orsat flue-gas testing apparatus has also been used frequently to help show the firemen what constitutes good firing. This has been a great help. A close watch is kept on power-station reports by the manager, and any unusual increase in fuel or water is immediately taken up with the power-plant men. Each 12-hour shift makes a report of coal burned, and ash taken out. Bristol gages record the steam pressure, incoming water temperature and voltage. The ash of the coal as determined by analysis, is 11.2 per cent. As determined by weight at the plant it is 12½ per cent, showing that the firemen get very good combustion. The cost of coal per kw-hour, including heating, is 1.5 cents. Four and one-half men are charged against the power station. From two to three outside men are employed in the electric end of the business. Recently a man has been placed in the store-room to keep track of stores—an experiment which was considered a doubtful economy for such a small plant at the time it was started. It seems to be paying well, however, as considerable waste of material has been stopped. The peak load for 1907 was 384 kilowatts, the load factor for the year being 24.5 per cent. The management of the company is under Mr. Ludwig Kemper.

Central Station Publicity.

By Andrew J. Haire, Jr.

Central-station publicity must necessarily be of an educational character. Few people realize how far the development of electricity has been carried. They cannot comprehend its mysterious mode of operation, and there is naturally, therefore, at least a negative attitude toward its installation in their homes. Then, again, there is the antagonistic spirit with which all public service corporations are now regarded. The publicity department of every central station has, therefore, certain definite handicaps to overcome before it can hope to extend the field of operation of its plant.

The commercial or business-getting activities of the average central station are carried on through two different methods; through personal solicitation and through advertising, which will be taken up in turn.

PERSONAL SOLICITATION.

The first qualification of the central-station solicitor is a thorough technical knowledge of electricity in its application to the particular class of business upon which he is working.

Salesmen generally are too apt to conclude that if they have met with success in one line, their chances of succeeding in another are practically assured. They forget that while every salesman, or business-getter, must possess certain general qualifications, such as good appearance, pleasing address, tact and perseverance, these are of little avail unless backed up by the specific qualifications required in every line. Since technical knowledge is so important a condition to the solicitor's success, a problem which the commercial department of every large power plant has to deal with is, how can this condition be best met? To employ graduate electrical and mechanical engineers as business solicitors is often impracticable. The solution of the problem seems, in fact, to lie in getting good raw salesmen material and in training and educating that material up to a promising degree of efficiency.

Different companies follow different methods of educating their solicitors, and it may be instructive to consider the systems of some of the larger manufacturers of illuminants as well as central stations. Many of these conduct courses in the study of electricity. These courses are open to the sales department as well as to the engineering departments, and it is probable that there is no more effective way of initiating the inexperienced salesman into the elementary mysteries of electricity. These study courses are generally supported, financially and otherwise, by the management of the plant. Probably every central station is provided with a more or less complete library of authoritative text books and technical magazines. These the solicitors are encouraged to study. In fact, it should be firmly impressed upon the selling staff that the more thoroughly the principles of electricity are understood, the greater are the chances of bringing in new business and consequently of drawing larger salaries.

Some electrical companies use, as the basis of the agent's initiation into the solicitation of electrical business, what is called the "agent's hand book." The Boston Edison Company, notably, has found this an excellent means of instructing its salesmen. Regarding this aid, Mr. R. S. Hale, general agent of the company, has to say:

"This hand book is, to my mind, the most important help to new-business-getting we have. We use the ordinary loose-leaf book of pocket size, either National Simplex No. 4241 or Unimatic No. 7752, and put in it all the hints, suggestions and orders touching the interest of the general agents' department. The general advice as to the qualifications and aims of the agent and the specific information about the company's business, which varies little from year to year, are printed in the regular way. Other details, regulations and explanations of particular points are got out on a multigraph machine and distributed as occasion serves. The ordinary hints are given numbers, from 1 to 100; the special advertising hints are of less importance and are numbered from 100 to 200, while a third series, giving prices and data in regard to current-consuming devices, is numbered from 200 to 300. This division is for the purpose of making it easier to find hints on special subjects."

Every qualification which goes to make up a good salesman in any line is essential to the central-station solicitor, and in this respect I cannot do better than quote in part the words of one of the speakers at the convention last year of the National Electric Light Association:

"Give me a man who is training himself systematically along the lines of endurance, ability, reliability and action, and I will show you a man who, all things considered, will outdistance his competitors. This man will realize that beyond the training of these faculties and qualities—which is the educative or first part of education—that he must also fill in with useful knowledge, which is the second part of education. Thus this man will make a scientific study of human nature his business. He will study types, temperaments, motives, habits of people. He will realize that it is a great mistake to handle everybody alike. While we all belong to certain types, yet no two people are constructed exactly alike. An ability to read his fellow man correctly is one of the greatest assets of the business man. While it is true that we pick up much knowledge from contact with our fellow men, it is also true that some of the greatest scientists in the world have spent their lifetime in a masterful study of this problem, and as a result of their study have been able to give us information that will remove our knowledge from the plane of guesswork to that of practical certainty. Once knowing how to read people through, the study of the types, temperaments, and so forth, as evidenced not only by their general shape of head, facial expression, but through the voice, through the gesture, through habit as evidenced by many things, we shall be able to obtain a mastery of the situation."

Solicitors for electric power companies are paid generally a straight salary supplemented by a commission based upon the net returns of the business secured. The commission should be limited so as not to exceed in any case the salary of the solicitor.

The work of the solicitor should be followed up by the company, both by good service and prompt correction of all complaints, on the part of the engineering department and by forceful newspaper advertising and mailing literature on the part of the advertising department. Much devolves upon the advertising manager in making the solicitor's work successful.

Are Issues of Capital Stock, Which Do Not Represent Cash Invested, Justifiable?

By W. H. Winslow.

Ask the average man whether or not, in his opinion, issues of capital stock in excess of physical assets are right or wrong, and he will probably, with "watered" stock in mind, promptly reply in the affirmative. Those who have given the subject some thought, however, know that whether or not such issues are wrong, depends on circumstances. The last report of the Interstate Commerce Commission contains these significant words: "We are aware that in the construction of new lines of railway, developing new territory, it has been necessary in many instances to sell railway securities at large discount, and to sell bonds with stock bonuses, and, even in such cases, it has many times been difficult to raise the necessary capital."

It is not clear to many, however, why this should be the case. What difference is there, they say, between subscribing cash to the capital of a concern and building the plant with such capital, or buying the bonds of the concern and getting a bonus of stock issued against franchise or other non-physical assets? Let us take a concrete example. Suppose that it is proposed to start some public utility in a small but growing community, and that the promoters decide not to issue any bonds, but to float stock at par, for the purpose of building the plant. Why should a man, with capital to invest, fight shy of such a proposition, when he is willing to invest in the bonds of the company, with a bonus of stock, as in either case he is assured of his share of the entire net earnings?

Let us suppose that the plant is built with cash received from sales of stock only, and that in a few years it becomes necessary to raise more capital for necessary extensions, and that it is found impossible to sell additional stock. The natural result is that the plant is mortgaged to raise the needed money, which mortgage becomes a first lien on the property, and one which, in a period of depression, or owing to adverse conditions, may be foreclosed and the stockholders left without anything to show for their money. In this connection it must be remembered that, unlike ordinary strictly private enterprises, public service corporations have frequently to raise additional capital, even when the return on that already invested is insufficient to make their securities attractive. The owners of a factory, for example, cannot be compelled to increase its capacity or even to keep running, unless they choose, but a public service corporation must not only keep running, but must increase its capacity to meet the needs of the public.

Suppose, on the other hand, that the plant is built with the proceeds of an issue of bonds secured by a first mortgage on the plant (sold with a stock bonus), which mortgage is made for a sum much in excess of the original issue of bonds, so that additional first mortgage bonds may be issued for extensions. Suppose, further, as in the other case, that the company falls on evil days, and the mortgage is foreclosed; our investor in this case may have his stock wiped out, but he is assured of his share of the proceeds of the sale of the property.

The giving of stock bonuses in untried enterprises to secure capital necessary for their development is, however, a very different thing from issuing such stock in concerns which have reached a position of assured permanency and earning power. It is this latter practice which has made the term "watered stock" anathema to the public. It would appear, then, that so-called "watered" stock is necessary and advantageous to the public under some conditions, and unnecessary and harmful to the public under others. Stated in another way, when enterprises are still in an untried and speculative state it is necessary to offer capital the inducement of a possible return much greater than can be secured in investments largely devoid of risk, while when the enterprises have demonstrated their earning power, no such inducement is required. In Great Britain this is recognized in dealing with gas companies, they being allowed to earn 10 or 12 per cent on the sums invested up to the point where they are firmly established, while on additional capital the return is limited to 5 or 6 per cent. It is, perhaps, only natural that when people see public utilities whose business has passed the earlier, uncertain stage paying good dividends on stock representing no cash investment, they should consider such a situation wrong; and, further, that they should consider the giving away of franchises which have proved so profitable as unwise and unnecessary. Let us, however, consider the situation at the time the grants were made. The writer has in mind a town where the usual franchises were granted about 20 years ago. At that time, the town was growing rapidly, and all of the credit of the municipality was needed to finance street improvements, sewers, schoolhouses and the like. Also the individuals of the community needed all their capital in developing their own business and, as a result, welcomed the coming of outside capital to works. This outside capital was willing to risk large sums of money on the ultimate growth of the town making them a handsome return for their investments on the usual basis of bonding the plants for their cost and issuing stock against the grants, charters and franchises owned. As a matter of fact, no such return has yet been made, and it has even been necessary to refund the bonds on a lower interest basis; thus, in this case, at least, the risks assumed were far from imaginary. There is still hope, however, that in the future dividends on the stock will, in part at least, compensate for the very slim return so far received. It is folly to suppose that at the time the plants referred to were built, any capital could have been secured on a less attractive basis, and, even should the stock ultimately pay dividends of 10 per cent, it would be a long time before the average return on the capital invested would reach 8 per cent. Is there anything here for the inhabitants of the town to condemn?

The public utilities of this country doubtless have much to answer for, but are the communities they serve so utterly without sin that an attitude of pious horror becomes them? Assuming that it is wrong for a public utility to earn more than a fair return on its securities, is it any less reprehensible for a community to let a utility struggle along for years, building up its business, and then when at last it begins to pay a fair return to try to acquire it for the value of its physical assets, or to force it to reduce its rates to a point where it will yield a return no greater than might have been secured in other ways, without any of the struggle and worry of those earlier years? In short, is it right that the merchants and land owners and all the others whose efforts have built up the town should reap to the full the profits of final success, while those alone who have invested in public utilities, and who, in many cases, have done as much as anyone to develop the town, should be forced to be content with a return on the money invested no greater than they would have received from investments entailing no work and very little risk?

The Law of Electric Light Companies.

By J. E. Brady.

In general, it may be said that electric-light companies are liable to persons injured through their negligence to the same extent as are individuals and other classes of corporations. There is nothing inherently different in the nature of electric-light companies which requires the application of different or unusual rules of law in actions for negligence where they are involved. The cases, however, very often present novel combinations of facts.

LIABILITY TO EMPLOYEES.

There are general rules of law applying especially to the relation of employer and employee which govern the duties of electric-light companies to their employees in the same manner as they regulate the obligations of any other employer; and, likewise, rules which prescribe the rights and obligations of the employees of such companies. Under these rules, it is presumed that every person of ordinary intelligence has knowledge of the destructive forces of nature. If the work he performs exposes him to danger from these forces, he assumes the risk of

the injury. Every man of experience in handling live wires will be taken to understand that he must use great prudence. The authorities generally announce that if the servant has full and equal knowledge with the master that the appliances used are defective, and each is equally indifferent to the danger, they will stand on a footing of equality as to damages. In the first place, however, it is the master's duty to be careful that his workman be not induced to work under the notion that the appliances are safe, when he knows or has reasonable ground to believe that they are dangerous. On the other hand, it is the duty of every workman to execute the work assigned to him with required care, and not to expose himself to the liability of injury. In other words, the general rules which determine the liability of a master to his servant for injuries to the servant apply as between the electric-light company and its employees. Smart vs. Electric Light Company, 47 La. Ann., 869.

In Colorado Electric Company vs. Lubbers, 11 Colo., 505, the defendant company, acting through one of its superintendents, sent out a carpenter in the employ of the company with instructions to remove a lamp in one of the electric light towers, connect the wires with the circuit, and return with the lamp to the works. At that season of the year the usual time for turning on the current was 4:45 p. m. on clear days and 4:30 p. m. on cloudy days. It was about 4:15 when the carpenter commenced work, and, while he was engaged in detaching the lamp, the current was turned on, causing him to fall to the pavement, sustaining permanent injuries. The carpenter was inexperienced in the work he was ordered to do, and it was outside the duties of his regular employment. He knew that it was dangerous to handle live wires, but, on the trial of his action against the company for damages, he testified that he did not know what a "jumper" was and had no knowledge of its functions or use. It was shown that, subsequent to the accident, the defendant company posted notices at its works warning all employees engaged at work on its lines to quit such work at 4 o'clock each day, and not to resume without first notifying the officers at the works. A judgment was given for the plaintiff on the theory that he had a right to rely upon the assumption that the current would not be turned on earlier than usual, and that by not waiting until the usual time the company was guilty of negligence. It was found necessary, however, to reverse the judgment because of the admission of the evidence as to the posting of notices after the accident. The liability of the company was to be determined on what took place before and at the time of the accident. What it did afterward, in the way of precaution, to avoid future accidents should not have been construed into an admission of a previous neglect of duty and should not have been submitted to the consideration of the jury.

In another case, the insulation having been burned off a portion of an electric-light wire by lightning, a night lineman was sent out to investigate. He found the fault, returned to the station and had the current shut off from the circuit. He then returned to the pole near which the trouble was located and, by pushing the handle of a cut-off box on the pole, made it impossible for the current to reach that pole. Current was again turned on, lighting all the lamps on the circuit but the one in question. Shortly afterward, a night patrolman, not having knowledge of the facts related, climbed the pole, turned on the current by means of the cut-off box, as it is his duty to do when trimmers had left it turned off, and received a shock which threw him to the ground and caused his death. It was here held that the defendant electric-light company was liable for damages under the Massachusetts employers' liability act. Willey vs. Boston Electric Light Company, 168 Mass., 40.

It is well settled law that the master must furnish the servant with reasonable safe appliances for the performance of his work. And if the master fails to do this, or fails to repair a defective apparatus, after reasonable time, then he will be responsible for the resulting damages thereby occasioned to the servant, provided, of course, the servant has himself exercised ordinary care for his own protection. If the servant engages in a hazardous employment, or attempts a service necessarily attended with danger, he will be held to assume all the risks ordinarily incident to the work. In other words, the employer is not an insurer of the safety of his employee. More than this, even where there are defects in the machinery or appliances given into the hands of the servants, still if the peril attending their use "is such as to be perfectly obvious to the sense of any man, whether master or servant, then the servant assumes the risk." Wray vs. Electric Light & Water Power Company, 68 Mo. App., 380, announces the above proposition of law, the facts therein showing that a lamp trimmer was injured as a result of a defect in a lamp, which was obvious to the most casual observer, and had existed for 18 days before the accident without any report or complaint from the lamp trimmer, whose duty it was to report to the lineman any defects on the circuit which he was unable to repair.

In the case of Smart vs. Electric Light Company, 47 La. Ann., 869, it appeared that one of two linemen working at the top of a pole was killed by a current received from the wires on which he was at work. The foreman in charge of the work sent gloves up to the men for their use. The one of the two who was not injured did not put on the gloves, but worked with his bare hands. The other donned the gloves, but being old and defective, they failed to serve the end for which they were intended and their wearer received a fatal shock. The evidence showed that the deceased lineman was competent and experienced and that it was the duty of the linemen to inspect their gloves and turn them in for new ones when they became unfit for use. The claim made by the plaintiff in the action against the company was that the wires upon which the accident occurred should have been made "dead" before the work was commenced. But under the rules of law as set forth above, it was held that the lineman had assumed the risk of injury resulting from the defective condition of the gloves and that the company was, therefore, not liable.

In Junior vs. Electric Light & Power Company, 127 Mo., 79, where a lineman, who had been supplied with rubber gloves with which to work, was killed while working without the gloves, it was held that there could be no recovery against the company, as the lineman had been guilty of contributory negligence. In that case the court held that the lineman by his own neglect of the means furnished him by his employer, brought his hands in contact with the wires and lost his life, and the master is not liable.

It was said in Electric Company vs. Kelly, 57 N. J. L., 100; "The better view of a master's duty to a servant is that which, taking into consideration the well-settled doctrine that a servant, by accepting employment, consents to take the risk of all dangers obviously or naturally incident to such employment, imposes on the master a positive duty to take reasonable care and precaution not to subject the servant to other or greater dangers. The rule thus formulated is of wide application, but with reference to such cases as that now under consideration (where a lineman was injured through the breaking of a pole on which he was at work) may be thus stated: The master must take reasonable care to have the tools and appliances with which, and the places on or about which, the servant is to be employed, reasonably safe for the work the latter is employed to do."

It is the duty of the master to inform the servant of peculiar dangers. The following is quoted from the case of Chicago Edison Company vs. Hudson, 66 Ill. App., 639: "The master is bound to inform his servant of all dangers incident to the service of which he, the master, is cognizant, or of which, in the exercise of ordinary care on his part, he would be informed; he is bound to warn the servant of all latent or extraneous dangers of which he himself has knowledge, or of which, in the exercise of ordinary care, he would be informed; and if he fail in this respect, he is liable to the servant for all the consequences resulting to him from lack of such warning. This rule applies to dangers of which the master himself is aware, or ought to know, and which are unknown to the ser-

vant, and would not be readily ascertained except by a person possessed of peculiar knowledge, which the master has no reason to suppose the servant possesses. Dangers which are the result of common knowledge, which can be readily seen by common observation, the servant assumes the risk of, but when the danger to be avoided requires a knowledge of scientific facts, an ordinary servant is not presumed to have knowledge of them, and it is the duty of the master, knowing of them, to inform the servant in respect thereto."

As to the master's duty to supply his servant with proper appliances, the following statement is taken from the case of Harroun vs. Brush Electric Light Company, 12 N. Y. App. Div., 126, 152 N. Y., 212, where it was held that the quoted instructions were correct: "The law requires not that degree of diligence and foresight which is required of an insurer, or which the law might require of a corporation towards the public, but simply reasonable care and prudence in the selection of safe and suitable appliances for the use of employees. * * * * While, in a general way, the law requires simply reasonable care and foresight by the employer in the selection and provision of appliances for the use of the employee, that care and prudence must be proportioned to what may properly be expected of him under the circumstances, and increases in a corresponding ratio with the danger and hazard necessarily connected with the use of appliances."

Electricity in Horticulture.

Weak electric currents have been applied to moistened earth in order to determine their effect on plant life, and all the experiments made tend to show that under certain conditions rapid growth results from such applications of electricity. A new use of electricity for obtaining somewhat similar results has been made by Mr. G. Hartman, of Turbine, Ontario, Canada, who converts the electrical energy into heat and applies the heat under a hotbed for vegetables and flowers. In the comparatively cold climate of Northern Ontario, a current of from 15 to 20 amperes at a potential of 110 volts has been found to be sufficient for a hotbed for a family garden. Figs. 1 and 2 show the arrangement of the heater, which has been successfully used for two seasons. The heater consists of about 260 ft. of No. 12 B. & S. gage iron wire wound in coils 2 in. in diameter. A piece of 1½-in. pipe was used in winding

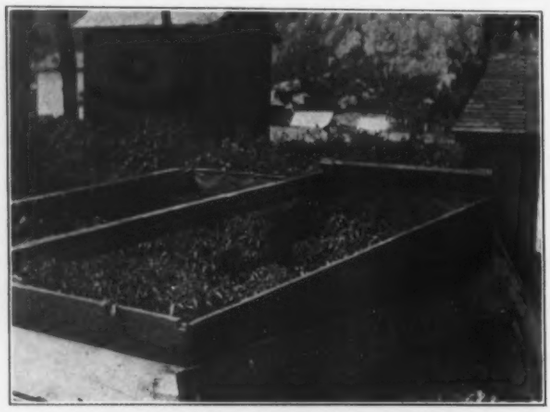


FIG. 1.—HOTBED HEATED BY ELECTRICITY.

the coil, which was afterward cut into seven parts and mounted on porcelain knobs on a piece of asbestos board, the coils being connected in series.

The heater was placed under a rough board frame about 6 ft. by 8 ft., the floor of which above the heater was covered with about 5 in. of earth, two hotbed sashes being used to cover the top of the frame. Electrical energy was taken from a 110-volt circuit, and owing to the line losses, the actual current received at the hotbed last year was 15 amperes at 80 volts. The previous year, a current of 18 amperes at 100 volts was obtained, and good results were obtained in both cases. The heat was found to be sufficient to keep the earth always noticeably warm, and in the cold early spring weather, tender flowers and

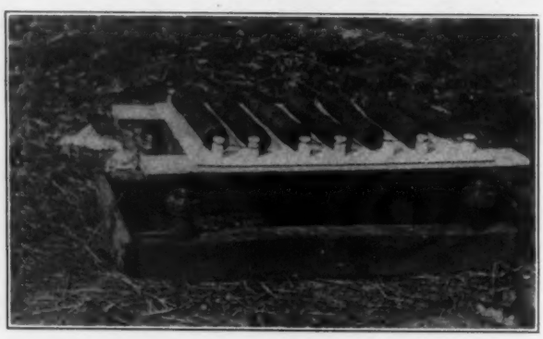


FIG. 2.—DETAILS OF HEATER.

vegetables grew rapidly. In some cases the growth was so rapid that the plants were large enough to be set out to advantage, were it not for the danger of frost.

Testing Electric Machinery.

By W. M. Hollis.

To many persons the testing of electric machinery appears be very complicated, to require many and expensive instruments, and to involve very technical formulas and operations. Such is undoubtedly the case in very many tests where extreme accuracy is required; but the tests given herewith are of very general application and do not require many measuring instruments or intricate calculations. Methods are also given for testing machinery of considerable size under practically full-load conditions, although the amount of power required is only a fraction of the power required at full load.

In testing dynamos and motors for efficiency it is usual to determine the losses, the output being equal to the input minus the losses. The losses may be divided into the electrical and mechanical losses, or may be divided into the heating losses, core losses and friction losses. The latter two losses are oftentimes combined and designated as the stray-power losses.

The measurements should be reduced to a minimum, and as few instruments as possible used in making them. In some cases the output and losses are measured, and in other cases the input and losses, while in still other cases the input and output are determined. With large machines, the last test is not easily made, and if made, is expensive. The other two tests are more easily made. The commercial efficiency in the cases mentioned is equal to the (input − losses) ÷ input or output ÷ (output + losses). The stray-power loss is, of course, equal to the difference between the total losses and the I^2R, or heat losses. Where the input and output are measured electrically, and also the I^2R losses, the stray-power loss may be readily obtained.

In the stray-power method of testing machines, the dynamo is adjusted to run at normal speed and under conditions such that the stray power is the same as when the dynamo is operated normally at the load desired. The efficiency at this load may thus be determined without the dynamo carrying the actual load. For instance, with a shunt-wound machine, values of the following would be required: field-coil resistance and armature resistance, hot; field current and armature current at no load. In addition, the normal voltage at the terminals would be required, the armature e.m.f., the full-load armature current, and the terminal voltage used in the tests.

In a dynamo the terminal voltage is equal to the normal voltage at the terminals plus the product of the armature resistance times the full-load armature current; or, in other words, the armature should be subjected to a voltage equal to the operating voltage at the terminals of the machine plus the voltage drop in the armature when operating under full load.

The usual method is to run the dynamo as a motor without load at normal speed by adjusting the field current. Under these conditions the back e.m.f. would be equal to the applied, very little current flowing into the armature, and this is the voltage generated by the machine when operating as a dynamo under full load. Since the machine is operating at normal speed, the flux must be the same as when the machine is operating as a dynamo, so that the hysteresis loss is the same. The current taken, times the operating voltage plus the full load voltage drop, is equal to all losses. Subtracting from this value the small amount of loss created by the "running light" current, which is a very small percentage of the full-load armature current, leaves the hysteresis and friction losses. The same method of obtaining efficiency can be applied to a motor, but in this case the voltage applied at the commutator should be the operating voltage minus the voltage drop in the armature.

The principle of the stray-power method for determining efficiency is as follows: When a dynamo is operating under full load and at normal speed and voltage, a certain amount of mechanical power is required to rotate the armature. The electrical power output is less than the mechanical power input because of the losses in the machine consisting, as before mentioned, of the heat losses and the stray-power losses. When the machine is driven at no load under normal conditions, the stray power is substantially the same as before. There is, of course, a small armature current due to the amount required to

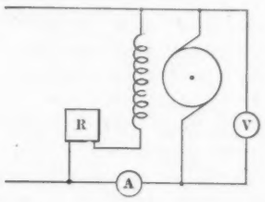


FIG. 1.—TESTING SHUNT-WOUND MOTOR.

excite the fields, but by separately exciting the field magnets this factor may be neglected. These armature heat losses are thus eliminated and the stray power is the amount of mechanical power required to drive the machine.

Ordinarily the measurements of mechanical power are very difficult to make, and they are, moreover, less accurate than electrical power measurements. Therefore, if electrical power measurements are substituted for mechanical power measurements; that is, electrical power is used to drive the machine as a motor under normal operating conditions with the field magnets separately excited, the stray-power losses will be equal to the electrical power input. Adding to this stray-power loss the value of the I^2R losses at full load, the total losses are obtained. The output is expressed in electrical terms, the measurements are electrical, and the calculations are thus very much simplified.

Another method of determining the efficiency is to use a motor to drive the dynamo under normal no-load conditions for the latter, and to measure the electrical power required to drive the motor. The driving motor is then disconnected from the dynamo and the power required to drive the motor is ascertained when it is operating under the same running conditions as before. The difference between the two values represents the stray-power loss of the dynamo.

A method of testing two similar machines at one time under full-load running conditions with the use of but a fraction of the full-load power of either machine is shown in Fig. 2. Here *M* and *G* are the machines to be tested, and are preferably rigidly connected. *D* is an additional dynamo used to supply the total losses of both machines. Machine *M* is used as a motor to drive machine *G* as a dynamo, and as the two are electrically connected, when full-load conditions are obtained, the dynamo *D* has to supply to the mains merely the total losses of the two machines. The conditions are substantially that of the dynamo *G* furnishing power to drive the motor *M*. The latter then drives the dynamo *G* through the mechanical connections shown. As there are electrical and mechanical losses, these are supplied by dynamo *D*.

An ammeter is used in the lines between the machines and the terminal voltages of the machines is obtained by means of the instruments shown. The field magnets are separately excited for normal full-load conditions. The current supplied by the dynamo *D* is measured also. There are several modifications of the method outlined above, whereby a less number

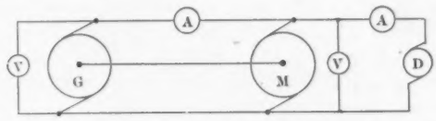


FIG. 2.—TESTING MACHINES UNDER FULL-LOAD CONDITIONS.

of measuring instruments are required and wherein the losses only are measured. Fig. 3 shows such a modification.

The stray-power method is of value in obtaining efficiencies, but does not give full-load running conditions or show up faults, such as sparking or overheating, which might develop under full load. For a long heat run, large amounts of power are required, and this is expensive. The method shown here is adapted for two similar machines mechanically connected, one being used as a dynamo and the other as a motor. The losses only, or a very small part of the total energy, is supplied from the mains or from an additional machine. The field magnets are separately excited in any suitable manner from a source of supply. A voltmeter is used to ascertain the voltage at the motor terminals, and an ammeter is placed in the leads between the two machines, and another ammeter is placed in the supply leads in order that the current used in supplying the losses may be found. The field magnets are separately excited for normal full-load conditions for each machine, and the motor is adjusted for normal speed and voltage. If I_1, I_2, and I_3 represent the current in dynamo *D*, motor *M* and the supply mains, respectively; V_1 and V_2 the voltage at the dynamo and motor terminals, respectively; R_1 and R_2 the resistance of the armatures of the dynamo and motor when warm, and L_1 and L_2 the stray power loss of the dynamo and motor, then $I_2 = (I_1 + I_3)$. The electrical input to the motor is $V_2I_2 = (V_2I_1 + V_2I_3) = V_2(I_1 + I_3)$. The dynamo output is equal to V_1I_1. The motor output is equal to the input at full load minus the losses, and the dynamo input, neglecting for the present the transmission losses, is equal to the motor output. The dynamo output is, there-

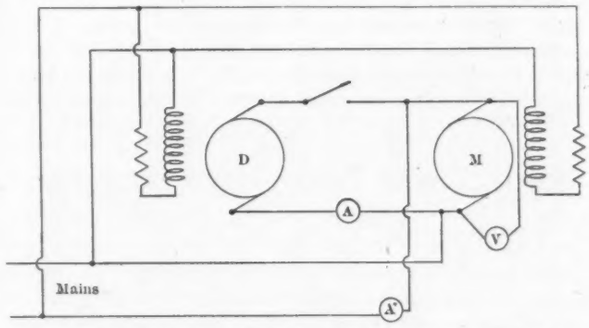


FIG. 3.—TESTING MACHINES UNDER FULL-LOAD CONDITIONS.

fore, equal to the input minus the losses. Now, the total losses are equal to $(V_2I_2 - V_1I_1)$ and as $V_1 = V_2$ the losses equal $V_2(I_2 - I_1)$ or V_2I_3. The watts supplied to the motor are equal to V_2I_2, and the watts output from the dynamo are V_1I_1 so that the combined efficiency is equal to $V_1I_1 \div V_2I_2$, and since $V_1 = V_2$, the efficiency in per cent may be expressed as $I_1 \div I_2$. If similar machines are used, the efficiencies are substantially the same. The efficiency of either machine is equal to the square root of the efficiency of both.

It is, of course, understood that any great differences would be brought out by the measurements made at first. It is also

well to reverse the arrangement and use the motor first as a dynamo in order to note any extreme variation. This method necessitates the use of an ammeter in the leads between the motor and dynamo, which, in the case of large machines, involves heavy currents, the measurements being at full-load values. Sometimes the above method is used simply to test a machine under full-load running conditions for a time sufficient to ascertain the maximum temperature of the parts and for noting any tendency to sparking or other possible defects, the efficiency having been previously obtained by the stray-power method. In such a case, the full-load current would not have to be used, and some appropriate form of current measuring device might answer. The machine used as a dynamo need not be similar to the one to be tested, but merely large enough to supply the amount of current required.

Since the losses in the motor and dynamo consist only of the I_2R armature losses and the stray power losses in each case, the armature resistances may be readily measured and thus the I^2R losses calculated and subtracted from the total losses. The total stray power losses will equal the product of the voltage at the motor terminals times the current in the supply leads (representing the losses) minus the sum of both I^2R losses of the machines. Having the stray power losses, the efficiency may be readily calculated as before.

To make a complete test, the efficiency may be obtained by the stray power method, and then with a pair of machines a heat run made at full load, when the machine may be observed for sparking or overheating. A machine of larger rating may be used with the machine to be tested, and if a heat run with full-load current only is desired, the voltage of the machine used as a dynamo need not necessarily be the same as the voltage of the machine to be tested. If a number of tests are to be made using the same machine as a dynamo each time, it may be advisable to test the machine for stray power losses at a number of different speeds and voltages, the values being kept for reference when testing other machines as motors.

An adjustable resistance should be inserted in the field circuits of each machine, and the one used as a motor should have a starting resistance in the armature circuit for use in starting. A switch should also be provided in the leads between the dynamo and motor. In starting, the motor should have its field magnets fully excited and the switch between it and the dynamo should be open, the motor being supplied at no load from the small additional dynamo or the supply mains, as the case may be. When the dynamo voltage and the line voltages are alike, the switch in the lead may be closed. The dynamo current and motor speed may then be adjusted and regulated by varying the field strengths of the dynamo and motor. It is of course understood that these adjustments shall be made slowly, since any sudden change may disturb the balance of the system and cause heavy currents to be drawn from the supply circuit.

Solving Some Power-House Problems.

By Geo. W. Martin.

As in every other line of work, the things that go to make up the daily routine of a power-house are not altogether the great problems, but rather the small details which occupy a considerable part of an engineer's time. One of the questions which are always of interest in a plant that is run condensing, is how to remove the oil from the condensed steam if it is desired to return the latter to the boiler. Some engineers shun an oil separator as they would the smallpox, and are content to allow the condensed steam to go to waste rather than run what to them is the risk of the oil getting into the boilers and causing considerable damage.

On the other hand, the experience of others has been that oil may be removed from condensed steam in an entirely satisfactory manner, and one quite often reads letters in the technical press from engineers who themselves have constructed oil separators which served the purpose in every respect. It is with some of these "home-made" devices that a part of this article will concern itself.

One arrangement which the writer has met with consists of two oil barrels joined together with a nipple at the bottom of the sides, as shown in Fig. 1, in this case the pipe being 4-in. To one side of the second barrel, as shown, a "goose neck" is fixed. Both barrels are two-thirds full of straw. The action of this oil separator is as follows: The water from the condenser empties into the first barrel, both barrels filling up to the level of the top of the goose neck. The oil will, of course, rise to the top of the water, but the straw is used as an additional safeguard to catch the oil and prevent it flowing with the water from one barrel to the other, and out of the goose neck.

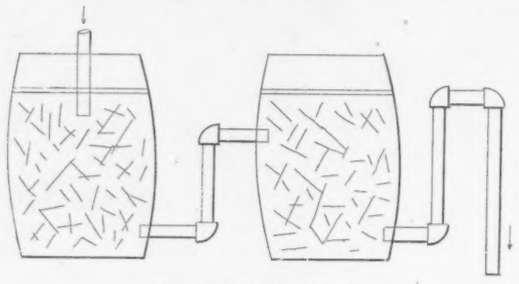


FIG. 1.—OIL SEPARATOR.

The object of the goose neck, as will be seen, is to keep the oil up as far as possible from the outlets of both barrels. As the oil accumulates it is skimmed off the top of the water. The straw may be renewed every month, or as often as experience proves it necessary. Adding another barrel, with the goose neck on the third barrel, will, of course, make a longer path for the oil to travel, and also give it another place to rise to the surface of the water. This may be necessary in certain-sized plants, but the two barrels will be found to be ample to take care of the water from a 1,000,000-gal. Worthington pump.

Should additional barrels be used, the arrangement would closely resemble another design of oil separator which has proved itself reliable. This is shown in Fig. 2, and consists of a tank divided into a number of compartments, one being connected to another by a goose neck. Here, as in Fig. 1, the water rises in each compartment to the level of the goose neck, the oil rising to the top and being either drained or skimmed off. The effect of the several compartments is to give the oil a greater chance to rise through the water to the level in each compartment.

Another design, which employs the same principle involved in Figs. 1 and 2, is shown in Fig. 3. A tank is divided into three compartments, the partition between the first two ending a short distance—3 in. or so—above the bottom, thus connecting the two compartments. The third compartment is connected with the second by a goose neck, as shown. The water enters the first compartment, the oil rising to the level of the goose neck, and the water in the second compartment also floats whatever oil may have come over from the first compartment. The upward turn of the goose neck at the bottom is to prevent any of the water from the first compartment flowing directly into the goose neck. In all the separators described, one of the chief points to be considered in their con-

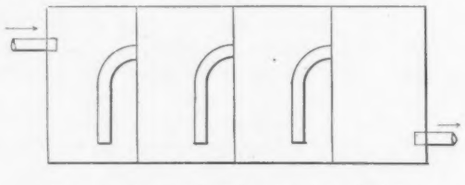


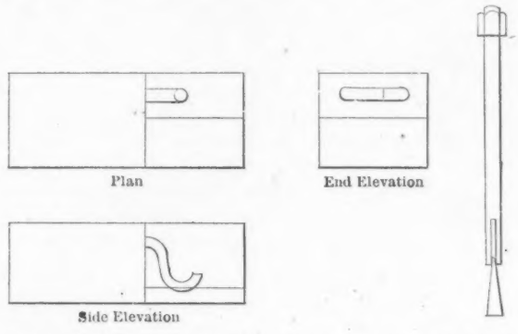
FIG. 2.—ARRANGEMENT OF OIL SEPARATOR.

struction is to prevent a direct flow of water from one compartment into another. The path of the water must be as broken and indirect as possible to give the oil ample opportunity to separate from the water.

Another matter of interest to an engineer is how to prevent water-hammer in a pump. More than one experienced man has had reason to remember the time and energy spent in trying to stop this trouble, yet the remedy is a very simple one. The difficulty is overcome merely by placing a pet-cock in the suction of the pump, leaving it open enough to admit a sufficient amount of air to cushion the strokes of the piston. If the size of the suction is below 8 in., a ⅛-in. cock may be found large enough. For larger sizes a ¼-in. cock may be necessary. In some cases a ⅛-in. pet-cock wide open has quieted a pump which before defied all efforts to remedy the trouble.

Still another "kink" is the use of wire screening, commonly known as "mosquito wire," to reinforce gaskets and prevent their blowing out of flanged steam joints. The screen is for use with any of the several varieties of packing similar to "Rainbow," and is placed in the joint on both sides of the gasket, holes being cut in it similar to those in the gasket. When the bolts are tightened up, the screen is pressed into the packing and serves to hold it together. With this arrangement the blowing out of a gasket is practically impossible with any of the pressures in common use.

A "home-made" expansion bolt is another item which has served its purpose well. It consists merely of a piece of round steel of the desired diameter and length, threaded at one end, a slit being cut in the other end for a distance of about 2



FIGS. 3 AND 4.—OIL SEPARATOR AND EXPANSION BOLT.

in. A wedge is also provided, made of machine steel, about the same length as the slit in the bolt, the wide end being about ½ in., or just enough to spread the end of the bolt to make it hold.

To set the bolt, it is placed in the hole in the wall, foundation or other masonry, the wedge being first driven in just enough to hold it, and a piece of lead is placed on the top of the bolt to receive the blows of a hammer. The bolt is then driven down, the wedge being forced into the slit, thus spreading the bottom apart and binding the bolt in the hole. This kind of expansion bolt could not, of course, be used above ⅝ or ½ in. in diameter, or in cases when the shock of driving it would injure the foundation or wall.

Regulation of the Draft of Steam-Boiler Furnaces.

BY W. H. WAKEMAN.

THE term draft as applied to steam-boiler practice means the difference between the weight of the column of hot gases inside the chimney and the weight of a column of air of the same size outside of the chimney. As the density of air and other gases varies with their absolute temperature, it is practicable to determine by calculation the difference in weight, or, in other words, the force of the draft in inches of water, and compare it with the readings of a draft gage.

The difference in weight may be determined by the following formula:

$$H \times (D - d) = P$$

in which H = height of the chimney in feet; D = density of the outside air; d = density of the hot gases, and P = pounds per cubic foot.

When the value of P is multiplied by 0.192 the product is the force of the draft in inches of water.

The value of D is determined by the following formula:

$$(493 \times .0807) \div A = D$$

in which A = the absolute temperature of the external air, or the temperature Fahrenheit + 461.

The value of d is determined by the following formula:

$$(493 \times .084) \div G = d$$

in which G = the absolute temperature of the hot air or gases.

As an illustration, take the case of a chimney 100 ft. high in which the gases are at a temperature of 440 deg., while the temperature of the external air is 70 deg. Fahr.

$$100 \times \left(\frac{493}{531} \times .0807\right) - \left(\frac{493}{901} \times .084\right) \times .192 = 0.556 \text{ in. o}$$

water. (See Fig. 1.)

A simple but correct draft gage can be made by heating a glass tube at the center and bending it into the form of the letter U. Fill it about one-half full of water and connect one side of it with the chimney flue, leaving the other side open to the atmosphere. It is not possible to read such a gage to thousandths, or even hundredths of an inch, but if it is applied to a chimney that is operated under conditions mentioned for the formula, it should show a full ½ in. Failure to do so may be caused by cooling of the gases as they ascend, therefore while the temperature is 440 deg. where the pyrometer is inserted, or 901 absolute, it may be much less near the top of the chimney, which would make the gases heavier and the draft is reduced accordingly.

In this example the chimney is assumed to be 100 ft. high, and as the draft varies directly as the height of the chimney, it may easily be calculated for any other height where the temperatures are the same. For illustration, suppose that the draft of a chimney 80 ft. high is required. For a chimney 100 ft. high the draft is 0.556 and for a chimney 80 ft. high it is $.556 \times .8 = 0.444$ in. of water. A chimney 135 ft. high would have a draft of $.556 \times 1.35 = 0.75$ in. of water. Analysis of rules and formulas for determining the force of chimney draft show that much depends on the temperature of the ascending gases, but it is not safe to carry this too far because what may be termed the limit of buoyancy is reached at about 600 deg. Fahr. For this reason it is a good idea to treat all temperatures above this point as if they were 600 deg., as the density of gases at higher temperatures decreases more than their velocity increases when moving through a chimney. Practically the same amount of air is forced through a furnace when the chimney gases escape at 600 deg. that when the chimney gases escape at a temperature of 800 deg. or more, so that this excess temperature represents a loss of heat.

When a draft measurement is taken at the base of a chimney the result is the "gross draft," because it is the highest that can be secured with that chimney. If the measurement is taken at the ash pit of a boiler furnace the result is the "net draft," because it is the draft actually available for the combustion of fuel. (See Fig. 2.) The difference between these two measurements is caused by friction of the air and hot gases as they are forced through the grates. Friction is also caused by the coal used, and it increases as the size of the coal decreases. The condition of the fire also affects the draft, as it is evident that air will pass through a clean fire more rapidly than it will through one containing a layer of ashes and clinkers several inches thick. Sharp turns in the combustion chamber and breeching of a boiler, also in the smoke pipe, add to the friction, and in some cases a large per cent of the total draft is used in this way. Where several boilers are connected to one chimney, the net draft of each may vary, and the variations may not always be the same.

Difference in the draft of chimneys indicates a difference in

the rate at which coal can be burned in the furnaces connected to these chimneys. Although the difference in draft varies directly with the height of the chimney, the rate of combustion which can be secured per square foot of grate surface per hour is equal to twice the square root of the height of the chimney minus one, according to Prof. Thurston's formula:

$$2\sqrt{H} - I = R$$

in which H = height of chimney in feet, and R = pounds of coal per hour per square foot of grate surface; so that with a chimney 50 ft. high 13 lb. of coal could be burned per square foot of grate and 19 lb. per square foot of grate could be burned with a chimney 100 ft. high. It is not difficult to find cases where more than 19 lb. of coal is burned per square foot of grate with a chimney 100 ft. high, while in others it is impossible to secure this rate, and in still others the rate of combustion can be secured for a short time, but it cannot be maintained. These differences do not prove the formula useless, as it forms a basis for results that can be secured under good conditions, and where the conditions are not good, due allowance must be made.

Prof. Kent gives the following formula for the horse-power of a chimney, or in other words, the horse-power of boilers for which it will give sufficient draft:

$$\text{Horse-power} = 3.33 \times E \times \sqrt{H}$$

in which E = effective area of the chimney in square feet, and H = height of the chimney in feet.

In order to cover all emergencies an allowance of 5 lb. of coal per horse-power per hour should be made. The effective area is nearly the same for square as for round chimneys, as the corners of a square chimney are not very effective, therefore if a chimney is 4 ft. sq. it should be taken as if it were round and 4 ft. in diameter. The formula is based on the assumption that the rate of combustion varies directly with the square root of the height of the chimney. When these formulas are used it is assumed that the size of the grate is properly proportioned for the area of the chimney. Firemen sometimes regulate the draft for their furnaces by the ash-pit doors, as illustrated in Fig. 3. These doors are shown closed, but the full draft power of the chimney is still in operation, hence cool air is drawn in through every crack and crevice, as indicated by the arrows. Of course, some settings provide more places for air to enter than others, but it is not practicable even with the best settings to prevent air leakage, hence there is always some loss on this account. The steam pressure ceases to rise, although the coal continues to burn slowly, because the heat thus produced is diluted with cold air and a direct loss is the result.

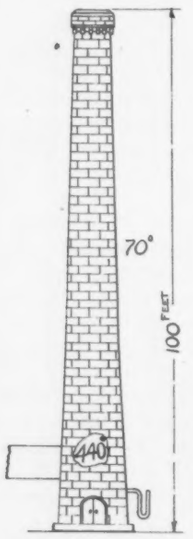


FIG. 1.—MEASURING DRAFT IN CHIMNEY.

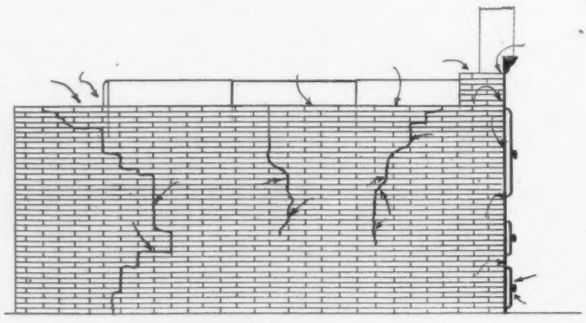


FIG. 3.—LEAKY BOILER SETTING.

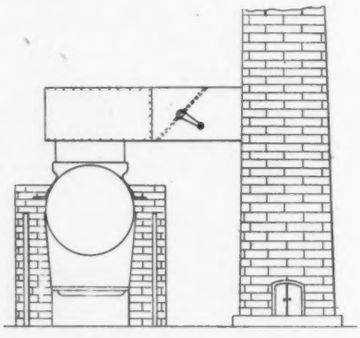


FIG. 4.—DAMPER IN FLUE.

On the other hand, when the damper is closed, as shown in Fig. 4, the force of the chimney draft is shut off, because there is only space enough around the damper to allow smoke to escape to the chimney. Boiler makers frequently make dampers such loose fits that combustion continues after the damper is shut as tight as it can be, hence the steam pressure continues to rise until the safety valve opens, thus allowing much valuable heat to be wasted. This refers to times when but little steam is used, and the only thing that the fireman can do is to close the ash-pit doors until an opportunity is found to close some of the open space around the damper, either by riveting on strips of sheet iron or by making a new damper.

Another plan which is often adopted by careless firemen is to simply open the furnace door when they desire to check the formation of steam. The coal continues to burn, but the large volume of cold air which is thus drawn in cools the furnace. This practice cannot be too strongly condemned.

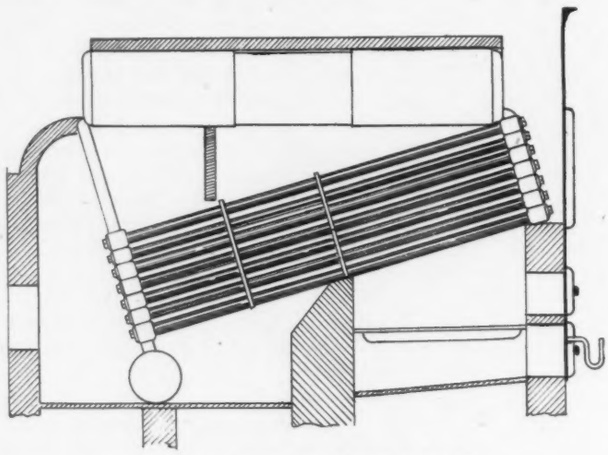


FIG. 2.—MEASURING DRAFT AT ASH PIT.

In the first plant in which the writer was employed as engineer, the damper was operated solely by hand, as an automatic appliance for this purpose was a luxury far beyond his ideas at that time. The engine was heavily loaded, making it necessary to carry as high a pressure as the inspector allowed, hence if the steam gage was not closely watched and the damper promptly shut, the safety valve opened and wasted steam at a rapid rate. The damper was then quickly closed, also the ash-pit door, in order to save heat, and when the pressure was lowered enough to let the safety valve close, they were opened and the performance was repeated.

Under such conditions it is plain that a good automatic damper regulator properly installed will save enough fuel to pay for itself in a few months; nevertheless, it is not safe to claim that even a superior regulator will save a given per cent of the steam used, without knowing the extent to which steam is wasted under present conditions, for it is possible to regulate a damper so closely by hand that it is not practicable to show a very great improvement by any other method. Such a plan calls for very close attention, hence the time thus spent will soon cost enough to pay for a good regulator that will last for many years and always be on guard. Automatic damper regulators will form the subject of a subsequent article.

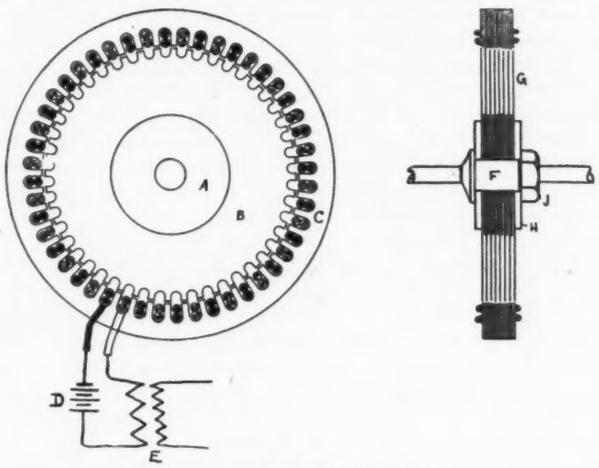
LETTERS ON PRACTICAL SUBJECTS

HIGH-FREQUENCY ALTERNATOR.

It has frequently been stated that a generator giving a frequency of 100,000 cycles or more would be a great aid in syntonic wireless telegraphy. The following is a description of a machine designed to be safely run to generate 240,000 cycles, and which could be made for large power requirements at relatively small cost.

The stator *C* is made of a very thin laminated iron wound with a single wire going down where marked black and coming up where cross-hatched. If for any particular case this does not give great enough flux, the winding could be arranged so as to form poles embracing several instead of only one tooth; but this, while giving greater flux, would also give greater self-induction, which would be objectionable. Low flux also means low hysteresis.

The rotor, *A B*, is made up of thin laminated iron, every other plate being small like *A*. If when the plates are mounted on the shaft, they are moistened with a sal ammoniac water, a slight coating of rust will be formed, and this when clamped by nut *J* and washers *H* will produce a structure capable of



HIGH-FREQUENCY ALTERNATOR.

running at very high speeds. The idea of employing friction as a means of reinforcing the plates at the center seems ridiculous at first thought, but if the sheets are .002-in. thick or less, and the radius of the plate *A* is 2 in., and coefficient of friction 1/10, a pressure produced by the nut of only 500 lb. per square inch of *A* will make it easier to pull *B* apart than to pull it out from between the plates *A*.

A storage battery *D* produces the exciting current, which flows in the same wire as the alternating current induced. When the teeth of *B* match those of *C*, the direct current flowing in the wire will produce a magnetic flux. When the teeth are pulled away, the diminishing flux will increase this current; when they approach the increasing flux will diminish this current. These variations will set up in the secondary of the transformer *E* an alternating current which, by properly proportioning the windings of *E*, can be given any desired voltage.

The absence of wire on the rotor, the high tensile strength of thin plates (which only need be annealed in the teeth and a short distance inside them), and the reinforcement provided by the plates *A*, make it safe to run the machine at something like 1000 ft. per second surface speed, giving a stress of somewhere between 20,000 and 30,000 lb. per square inch. If the slots are the width of an ordinary hack-saw cut or 1/32 in., 20 slots per inch can be used and wound with No. 24 wire. The frequency would then be 1000 ft. × 12 in. × 20 = 240,000 cycles per second.

It would, of course, require very careful workmanship and close clearance, say 1/100 in., and it would be wise no doubt to enclose the machine in a stout steel case, but there is no insurmountable difficulty involved in the design.

East Pittsburg, Pa. A. T. Kasley.

PECULIAR BEHAVIOR OF COMPOUND-WOUND MOTOR.

A communication in the March issue regarding the wiring of a compound-wound motor calls to mind a peculiar occurrence which came under the writer's notice two years ago. A 220-volt, 50-hp compound-wound motor was used to drive a haulage cable for shifting cars. The motor was differentially compounded to maintain an even speed at all loads. As the writer passed near the house containing the motor, the operator ran out and said the motor was acting badly and would run backward once in a while. As the man was excited and not well informed, I said nothing, but guessed he was wrong in one sense at least. If the breaker flew out the counterweights (six tons) would overhaul the motor eight or ten turns, but he maintained it did not throw the breaker until after reversing. There was considerable solder thrown out and the brush holders were pitted and spattered with melted brass. The motor ran all right for a short time, and then the ammeter showed some overload, and the motor slowed down a little and then with a roar started backward, throwing fire and solder. I knocked out the circuit-breaker, or reached for it, rather, as it flew out. I had to think out a cause for the occurrence and found the following to be the only reasons I could give:

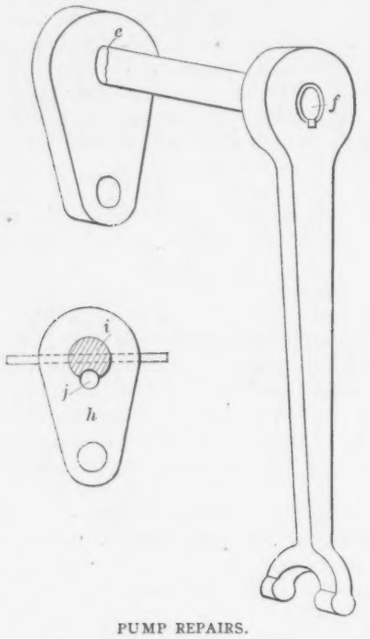
The heavy load caused a strong armature current, which displaced the line of commutation somewhat and weakened the shunt field enough to nullify it. The heavy current in the series coils helped the armature and killed the effect of the shunt field, and finally changed the polarity of the poles, and then reversed the direction of rotation of the armature. The sparking was caused by the heavy current and also by the line of communication being shifted away from the brushes. When this motor was installed there was trouble of a peculiar nature. The wires from the pole line entered the house at the eaves and passed down inside to the switchboard. From the starting-box the wires passed through and under the floor, and through the foundation to the motor base. The motor not being intended to reverse, had three wires run to it, the positive lead to armature wire at the terminal block, the negative to the series-field coils. A small wire, also positive, went to (+ *F*) the shunt-field coils. The leads marked *A*-2 and *S*-1 were jumpered together, and the negative shunt-field wire was tapped onto the negative series coils. This gave a straight job of wiring and no chance for mistakes; besides a print came with the machine. But the men in the dark under the floor crossed the heavy wires and did not see it, and when the wires were shoved up through the foundation they said their positions were the same as those of the wires which went through the floor at the board. The south wire was positive, the middle negative, and the north wire was the shunt wire. In the hurry of getting the machine started, no tests were made with the voltmeter, as everyone was sure the wires were right. The motor started all right and certainly tried to do its best. It ran at a speed of 1800 r.p.m. instead of 1000 before anyone got near the circuit-breaker. It also ran in a reverse direction to that intended. Six or seven men looked at the motor at once and found nothing the matter. Later on a test for voltage and polarity was made, and we found that the wires were crossed and this threw the shunt-field connections on the same side of the armature and short-circuited it. All voltage it got was dropped over resistance grids. Being differentially compounded, the motor ran reversed as a series machine, and these fields were small and weak (just a slight governing effect was all that was wanted). When the motor leads were straightened out and the connections tested and known to be correct, the motor started at regular speed and in the right direction, and gave no trouble until it began to run backward occasionally as described in the first part of this letter.

Conneaut, Ohio. Chas. M. Green.

DOUBTFUL PUMP REPAIRS.

Your correspondent was recently inside an electric-light station just as the valve-moving lever broke on a duplex feed pump supplying water to a steam boiler. The broken part looked something like the illustration below, the break occurring at *e*, the piece *h* coming loose. Inspection revealed the fact that the arms and shaft were nothing but cast-iron, and the wonder was it did the work so long without breaking.

Repairs had to be made in a hurry, and the engineer proceeded to belie his claim to that title. Never for a minute did he stop to consider the strain likely to be placed upon the lever and shaft when the pump was working, nor did he think what the parts would have to do should the pump commence short-stroking. Instead, the broken parts were rushed to the nearest repair shop and instructions given to drill a hole entirely



PUMP REPAIRS.

through shaft and all, as shown at *f*, and to put a ½-in. bolt through the whole, the shaft itself being only ⅞ in. in diameter.

The result can be imagined, and three strokes of the pump sufficed to cripple the outfit again. Then the part was started town-ward again, and the shaft, which was solid with the crank *h*, was drilled out and a new steel shaft put in place. as shown in the detail sketch, at *i*. To hold the new shaft a pin *g* was put through the crank and shaft, and the levers put in place in the pump again. Near midnight the crank and shaft developed the characteristics of a wire cutter, and the engineer was kept mighty busy the rest of the night, putting new pins in the pump rock-shaft. The trouble was finally overcome by putting in a pin, as shown at *j*. The experience of the engineer should serve as an incentive for engineers to do a little thinking for themselves, thereby saving much useless work.

Scranton, Pa. John Scott.

DRYING OUT ARMATURES AND FIELD COILS.

Among the many points necessary for the proper care and maintenance of electrical machinery, the matter of freedom from grounds and proper insulation resistance is an important one. Sometimes parts of a machine, in shipment, such as the armature or fields, become wet and, of course, must be dried before installing or operating, or a large dynamo or motor may accidentally be wet while in position. Now the ordinary installation or power station is not provided with a drying oven, so other means must be found.

Such moist condition would ordinarily be discovered by inspection or after a test of insulation resistance or for grounds. Suppose first that the machine is installed, and tests show simply a lowering of the insulation resistance and the presence of moisture. If the field coils are damp such coils should be connected to the supply mains, and a current at a greatly reduced voltage sent through them, such current being gradually increased and the coil dried until the moisture is completely driven out.

If necessary some sort of a drying oven may be improvised for the coils, care being taken not to have the temperature too high. With a damp armature, and especially for a good-sized machine, the method of sending a current of electricity through it is usually more practicable.

Usually the best way is to operate the machine as a motor, sending heavy currents through the armature, but at a voltage at first very much less than the normal voltage. Such voltage could be readily obtained by placing a temporary resistance in series with the armature circuit, or using some low-voltage mains or machines, if such are available. Such current should be kept on until the armature is throughly dried, preferably for several hours. The armature temperature should not be allowed to become very greatly in excess of the full-load temperature after a run of several hours.

If the armature is not in place in the machine, some sort of a clamping device may be improvised for holding brushes in contact with the commutator. The armature resistance is, of course, very low, and connection might be made in series to a circuit carrying a current equal to the full-load current. In such case great care should be taken to have a good, substantial contact surface. There should preferably be a resistance shunted round it at the start, and the armature current gradually increased by increasing the shunt resistance. Any possibility of burning the commutator is thus prevented due to insufficient contact by suddenly throwing on the full current.

Various modifications will, of course, readily suggest themselves for open-coil armature and alternators, a lower voltage than normal being used at first and the full-load current not being greatly exceeded in any case.

The great difference in the case of the voltage applied to the armature when in place with the fields excited, and of the voltage when the armature is not in the machine, is due to the counter e.m.f. set up in a rotating armature, which so greatly reduces the current flowing; consequently, with the armature not in place, it should be treated as a very low resistance and should not, of course be attached directly to the mains ordinarily used for the machine without some considerable resistance, as a water rheostat, in series.

A convenient form of water rheostat can be easily made out of a heavy cask or barrel, a pair of iron plates suspended therein, and wires attached to the same, the barrel containing water in which salt or soda has been dissolved. Preferably at first clear water should be used and the salt gradually added until the resistance is approximately correct. Or a heavy iron plate could be placed in the bottom, with a wire attached, and another plate suspended near the top of the liquid, which may be raised or lowered, thus varying the resistance.

Brooklyn, N. Y. James L. Longworth.

WIRING OF BURGLAR CIRCUITS.

I note in last month's issue a description by Mr. George H. Jones of a scheme for wiring lamps for emergency use so that these may be lighted from the owner's chamber. It would appear from the description that this was an entirely new scheme. Such, however, is not the case. Schemes of this kind have been in use for a number of years, and a very simple diagram of connections is shown in the Standard Handbook for Electrical Engineers. In that book a burglar circuit is described as an arrangement whereby a number of lamps throughout a house may be lighted by a switch, usually placed in the owner's chamber, irrespective of other switch control, except, of course, any switch at a lamp socket. The circuit is installed by means of three-way switches with one terminal connected to the lamps, one other point to the main and the other point to an extra wire running to the special switch. All three-way switches must be cut in on the same main.

Philadelphia, Pa. Frederic Kendron.

PECULIAR ELECTRICAL PHENOMENON.

In the March number Mr. Frank W. Merrill described a peculiar electrical phenomenon observed by him and asked for a theory to account for the peculiar occurrence. I should judge that the trouble is due to a ground which occurs on opposite sides of a live electrical system and is equivalent to a short circuit. It would appear that two or three of the incandescent lamp circuits were grounded on one side and that the arc lamp circuit was grounded on the frame of the first lamp or somewhere in the lead connected to the bus having a polarity opposite to that of the grounded lead on the incandescent lamp circuit. When both switches were closed the circuit was from one bus to one blade of the main switch, through the grounds on the several incandescent lamp circuits to the grounded lamp or arc lead to one side of the arc lamp switch to the opposite bus. This would account for the fuses blowing on one side of each of the grounded incandescent lamp circuits and of the arc lamp switch and main switch. If the other fuses were blown and the switches burned, it could be accounted for by the arc being formed across the switches by the burning off of the lead or by the blowing of the fuses; the blowing of the fuses not being sufficient to open the circuit carrying the excessive load due to the short circuit. After the leads to the arc lamp circuit were reversed, the ground was thrown on the side of the circuit which was connected to the same bus to which the grounded side of the incandescent lamp circuit was connected, so that the short circuit was cleared. The arc lamp should be equipped with resistance coils for use upon constant-potential circuits and the resistance of the arc lamp circuit would be high enough to prohibit such an excessive amount of current to flow as to cause the damage detailed.

Georgetown, Wash. A. B. Case.

Referring to Mr. Merrill's experience with the 550-volt lighting system, it appears to me that his trouble was due to defective wiring. This would be also indicated by the trouble disappearing when he reversed the arc lamp leads, which was undoubtedly done at the switchboard. I know of no lamp that will refuse to pick up if the current is sent in the wrong direction. The system is probably a railroad system, and there must have been a contact between the arc lamp and incandescent lamp circuits of opposite polarity; and when the arc lamp switch was closed, it probably arced at the contact or contacts, and might have arced to some grounded conductor, and made the main switch carry more current than the arc lamp switch. The main switch probably was twisted out of shape and made poor contact at the blades and at the lead that fused so that the excessive current melted the switch at those points. Reversing the arc lamp leads would throw the contacts together at the same polarity.

The above reminds me of a case in the early days of lighting, where an iron ship was wired in port, but the wiring could not be tested before the ship left port. The electrician tested the circuits as the vessel left port, but almost every fuse blew, so he immediately tested out and connected all the grounded sides together, where only one side of the circuit was grounded, and operated the circuits that way until he could clear the balance of the system. This was in the days when real wiremen were few and far between, and anyone that knew the difference between an insulated and bare wire was an "electrician."

Reno, Nev. F. O. Broili.

HOME-MADE MOTOR-DRIVEN BORING TOOL.

The accompanying illustration shows a home-made boring tool which the writer got up for boring holes in joists for a knob-and-tube wiring job. The device was a success in every respect and paid for itself on this one job. The building to be wired is a three-story structure, 65 ft. x 140 ft., with floor joists spaced 16 in. centers. The system of wiring called for 300 lamps and 110 outlets. A rough estimate showed that the boring of joists necessary to install the wiring was equivalent to boring through 550 ft. of solid timber. To bore the necessary number of holes by hand would be a herculean task even with the improved forms of boring tools, and the time required would also have been great. With the tool shown, the task of boring the holes was finished in 12 hours. In making the device, part of an Anthony boring tool was used, together with a 7-in. V-grooved wooden pulley, a piece of ½-in. gas pipe, two buggy axle clamps, a piece of sash cord for a belt, a board ¼ in. x 4 in x 8 ft. and a 1/6-hp motor. The machine

HOME-MADE MOTOR-DRIVEN BORING TOOL.

can be adjusted for any height of ceiling between the limits of 8 ft. and 16 ft. It is easily handled, and the motor, which is the heaviest part of the mechanism, is placed on the board about 7 ft. from the ceiling so that ordinarily it will be at about the level of one's waist. The combination is original with the writer, who feels that it may be of use to those who, having similar work to perform, desire to get up a labor-saving device somewhat similar to it. No doubt it can be improved upon, but as a first attempt it certainly was a success. It is operated like the ordinary boring tools with which all wiremen are familiar, the motor doing the work instead.

Hillsboro, Tex. E. D. Kelly.

SHUTDOWN CAUSED BY IMPROPER USE OF VALVE AND BY FAULTY PIPING.

A provoking little accident happened through the action of an engineer who made a practice of running engines with the throttle partially open. For some time there had been a rattling and a clicking sound in the throttle valve, and the engineer was intending to take down the valve and investigate matters, but he was prevented from doing so as the valve suddenly refused to be closed, and it was necessary to shut-down the engine by means of the governor in order to stop it at all. The piping was so connected that it was impossible to cut out the engine without closing down another engine, which could not well be spared. As soon as the other engine could be laid off, the balky throttle was investigated, and it was found to be

completely out of business. It was a valve of the disk type and the attachment of the spindle to the disk was worn so badly that the disk had fallen from the stem and had become so jammed that the valve could not be closed. It was evident that the undue wear of the disk-spindle mechanism was due solely to the constant movement of the disk, caused in its partially opened condition by the pulsating movement of the steam supply. A little investigation revealed the cause for partially opened throttle valves. It seems that the engineer had previously run engines, upon two separate occasions, which were fitted with defective governing apparatus, and which would sometimes stick and allow the engine speed to run up 10 per cent to 15 per cent before the governor would act. Then, the governor would stick in its new position, allowing the speed to fall 10 per cent to 15 per cent again, before the governor could act and meet the new conditions. This allowed the speed to "see-saw" constantly, to the great detriment of the voltage regulation. Whenever the light commenced to flicker, the engineer would partially close the throttle until the governor lost control, when the "waving" of the light would stop. In this way, after an experience with two engines of similar character, the engineer got into the habit of running engines with the throttle closed down to the point where the governor took control of the engine. Had the governor mechanism been overhauled, as it should have been, at the time the light began to flicker the ruin of half a dozen throttle valves would not have resulted, several tons of coal would not have been needlessly burned to furnish throttled steam to several engines, and it would not have been necessary to shut down two engines for two days. The engineer should not be blamed for the closing down of the second engine, even though he was the primary cause of that action. The man who designed the piping was the man who was to blame for the second engine going out of commission while the valve was repaired, for no good engineer should so arrange two large engines that there is no way of cutting them out individually, except by the throttle valve. Every throttle is liable to get out of order, and to need overhauling at any time; therefore, there should have been another stop-valve in the steam pipe, besides the one at the boilers, by means of which the two engines were cut out while repairs were made to the valve. Two valves should be placed in each large steam pipe to engines.

New York City. James Francis.

THE OPERATION OF A SMALL ELECTRIC PLANT.

In the March issue I notice a contribution from Ralph B. Coleman with which I wish to take issue. He states that Mr. W. H. Wakeman's arrangement of wiring a compound-wound motor is wrong, and then submits a sketch in which the starting-box is drawn wrong. I never saw a starting-box with a no-voltage coil located at the end of the arc swept by the controller. Perhaps such boxes exist, but the main point is this: either he left out part of the wiring or else he taps his no-voltage coil off the last step of the resistance in box. This resistance, if passing field current, would have hardly any effect on the voltage applied to field coils, but with the heavy rush of current into the stationary armature the drop caused by the resistance is large and the shunt field becomes weakened and allows one of two conditions to occur. Either the armature speeds up on a weak field and subjects the machinery to mechanical strains, or else if the motor starts on load the box allows the armature to lag behind its calculated speed at each step and then passes an excess of current through the armature and increases the voltage drop due to the resistance and thus further weakens the shunt field. The series field will hardly be strong enough alone to keep the armature down to a safe speed when running light, or to give a speed high enough when the motor is loaded. If the motor had heavy series-field coils and just enough shunt coils for safety to hold the armature speed down when running light, the starting-box, as shown, would not cause any trouble, but even then it would not be correct. Regarding fuses, I know of enclosed fuse blocks where a 10- or a 35-amp. cartridge will both fit equally well. A still larger size will take fuses of 35 to 60 amperes.

Cincinnati, Ohio. Chas. G. Morrison.

STRAIGHTENING IRON POLES AND ARMATURE SHAFTS.

An electric light and power company operating in a rather large city found itself possessed of a large number of steel poles which had become bent by various fires, in collisions with heavy trucks and by the numberless accidents to which line material is continually being subjected. The curtailment of

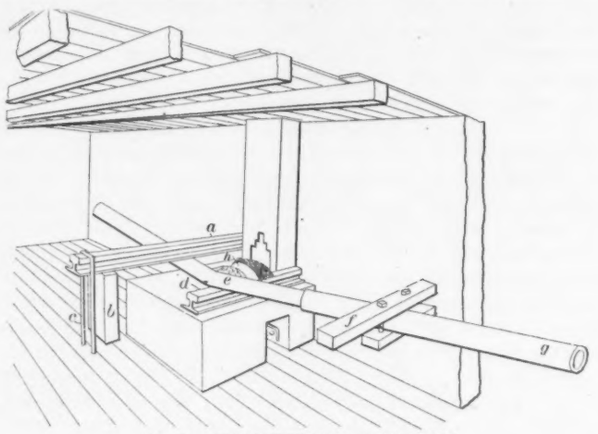


FIG. 1.—STRAIGHTENING IRON POLES.

expenditures during the recent short-money period led the superintendent of construction to look at the pile of bent and twisted poles and he determined to see what could be done toward straightening them.

After some consultation a forge was built in one of the storage sheds where there was plenty of room to handle 60-ft. poles. Wind for the blast was obtained from a blower.

The forge was built up of brick well laid in cement mortar to form a solid bearing for the piece of 110-lb. rail shown at *d*. This rail was loose, and could be shifted to any desired place on top of the forge, which was leveled off and made solid with a coating of rich cement mortar about 1-in. thick spread on top of the brick work. The railroad iron could stand hard usage without destroying the cement base upon which it stood.

Another piece of heavy rail *a* was placed as shown, about 10 in. clear above the cement top of the forge. This piece of rail was held very firmly in place, one end being built into the 17-in. brick wall, while the other end of the rail was supported upon a block *b* and fastened to a heavy "dead-man" by means of the U-bolt *c*. One smith and two helpers handled the poles easily.

The method of straightening the poles was as follows: A bent pole would be placed in the fire *h* and heat applied to the bent portion. The pole would then be pulled out of the fire and placed as shown by Fig. 1, the knee or elbow of the bend *e* resting on the rail *d*. A man at *g* would then pull down on the end of the pole, and if his weight did not prove sufficient, an-

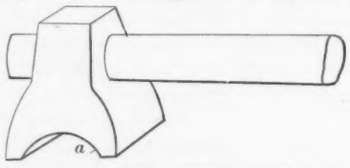


FIG. 2.—TOOL FOR STRAIGHTENING POLES.

other man would take hold with him. A weight of 400 lb. to 500 lb. applied at *g* seldom failed to bend the pole as desired, but sometimes there were ugly double bends and twists which made it impossible to hold the pole in place to bend it where needed. When this happened, the planks *f* would be placed in position as shown and the bolts tightened. This kept the pole from twisting sidewise when the strain was applied.

When the bend happened to be close to the lower end of the pole, or what would be the lower end of the pole when the pole was erected, the pole was reversed, the large end going into the

fire and the small end being used as a lever. Sometimes it was found almost impossible to take out the short kinks and bends which really did little harm except that they spoiled the neat appearance of the pole. A way was finally devised whereby the little, short bends could be taken out as easily as the large ones. For this purpose a tool was made, as shown by Fig. 2, the curve *a* being made a trifle larger than the biggest portion of the pole

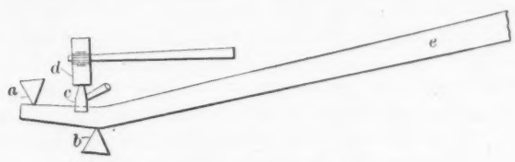


FIG. 3.—STRAIGHTENING BY PEENING.

—just large enough, in fact, so that the corners of the tool would not leave marks on the pole when used under heavy sledge blows.

To use this tool, the pole was placed as indicated in Fig. 3 with the concave portion on top, and directly over the bearing *b*. Strain was put upon the pole at *e*, and while one man was applying strain at *e*, the smith held the hollow-faced tool as shown at *c*, and the third man wielded the sledge, which had the effect of slightly peening or stretching the side of the pole where tool *c* was placed. With a comparatively light strain on the pole at *e*, several smart blows of the sledge at *c* would take out short kinks and make the pole straight. It was frequently necessary to turn the pole about 90 deg. and swage either side a little, so as to round up the cross-section again if it was flattened a little by the sledge blows.

The writer has frequently applied the same method for straighening shafts in machines, particularly armature shafts and motor shafts which had become bent or sprung through accident. A good, stout lathe may be used for straightening armature shafts, as indicated in Fig. 4, though it would be better to rig a special machine for this business if much straightening has to be done, as such work is a trifle too rough for a lathe.

Having located the point where the shaft is bent, mark the hollow of the bend with chalk, place the mark uppermost and pry directly under the shaft, opposite the mark, with a bar or some kind of lever. Have a small hand tool made something like that shown by Fig. 2, only smaller, and with a thickness not over one-quarter the diameter of the shaft, and while a strain is placed upon the armature shaft by means of the bar *b*, Fig. 4, strike the tool *d* several smart blows with the hammer *e*, rotate the shaft again and note the effect of the peening. A convenient way of obtaining a fulcrum is shown at *c*, where the back end of a tool is shown in the tool-post, but turned at

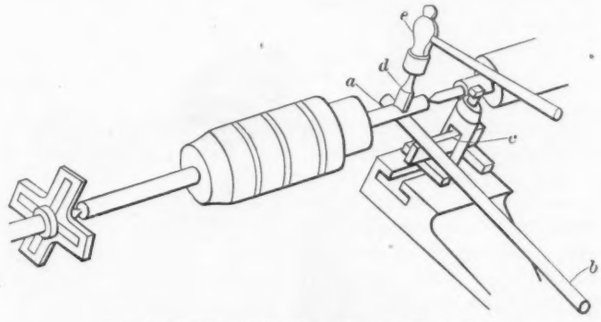


FIG. 4.—PEENING SMALL ARMATURE SHAFT.

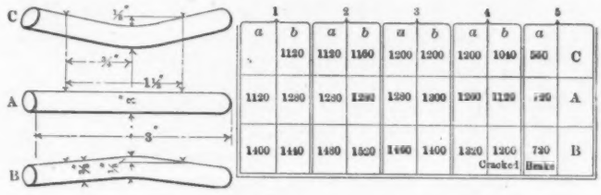
right-angles to the usual position of the tool. A few pieces of steel, or two other tools, are placed under the fulcrum tool to make the lever bearing as solid as possible.

This method of straightening shafts enables work to be done right close to an armature or other object which may be on the shaft, and it seems to the writer that the shaft is not as apt to bend again in the same place as when the straightening is done entirely by transverse force. The hammering seems to toughen the shaft where it would otherwise be weakened by the bending.

To determine how much the strength of the shaft or its resistance to bending is increased by bending and straightening, the writer made some tests expressly for use with this letter. A piece of ordinary ⅜-in. bar iron (soft steel) was procured and a piece about 3 in. long was cut off and put into the testing machine upon knife edges 1/16 in. wide and 1½ in. apart. The bending knife-edge was midway between the supporting knife edges and ¾ in. distant from either, as shown by Fig. 5.

Pressure was applied, and 1120 lb. was registered before the bar began to deflect noticeably. To bend the bar ⅛ in. required a pressure of 1400 lb., as shown at *1-a-B*. The bar was then removed from the testing machine and bore the appearance shown by *B*, Fig. 5, being bent ⅛ in., as stated. The bar was then replaced in the machine, but bottom side up, as shown at *C*, and pressure again applied. The bar did not begin to straighten until 1120 lb. was registered—the initial bending strain—and it required 1280 lb. to straighten the bar. The pressure was increased and the bar bent ⅛ in., in the opposite direction, which required 1440 lb. for its accomplishment, 40 lb. more than was required to first bend the bar ⅛ in.

The bar was again reversed, this time being placed in the machine as originally located. The bar commenced to straighten (*2-a-C*) at 1280 lb. as before, but required 40 lb. more to bend it the ⅛ in., although the bar straightened under the same pressure that was originally required to straighten it. In fact, the same pressure was required to straighten, in all cases, up to



	1		2		3		4		5	
	a	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	
C		1120	1120	1160	1200	1200	1200	1040	560	C
A	1120	1280	1280	1280	1280	1300	1200	1120	720	A
B	1400	1440	1480	1520	1460	1400	1320 Cracked	1200	720 Broke	B

FIG. 5.—STRAIGHTENING RESISTANCE OF A SHAFT.

3-b-A, when 1300 lb. was required, after which the pressure the bar would stand when straight constantly decreased until rupture occurred.

The strain necessary to bend the bar ⅛ in. increased in a very constant manner until the fourth bend, or two bendings and two straightenings, and another bending in an opposite direction to the first bend, when the pressure required to bend the bar ⅛ in. was 1520 lb. The increase in power necessary to make the second ⅛ in. bend was 28½ per cent; the increase for the third bend was 27 4/5 per cent, and for the fourth bend, 27 per cent of the power applied in making the preceding bend.

The curious thing about this test is that the power required to straighten the bar, also the strain which the bar would sustain without bending, increased after the power necessary to bend the bar ⅛ in. had fallen by 60-lb. jumps from 1520 lb. to 140 lb. The strain necessary to begin to straighten had increased to 1200 lb. (*3-C*), and the strain which the bar would carry, after it had been straightened, increased 15⅝ per cent to 1300 lb. The bar cracked at the eighth bend (*4-b-B*), and at the last straightening before this crack developed, it will be noted (*4-b-A*) that the bar carried exactly the same strain that it did in the first test (*1-a-A*).

From a study of the data given it is safe to assume that armature shafts will bear repeated bendings and straightenings without apparent loss of strength, until they finally crack during the straighening operation, and that cracks need not be looked for in the kind of material used in this test, at least, until seven or eight bends have been made, back and forth, in one direction or the other. In the case of street-railway motors, where bending is of frequent occurrence, due to a breaking of the gears or of the gear bolts, it would be very interesting to know to what extent the strength of the shaft is affected by the crystallization due to the constant hammering of the axle as the car bumps over rail-joints, mile after mile.

Willoughby, Ohio. James F. Hobart.

QUESTIONS AND ANSWERS

Can a covering be placed over a tangential water wheel to deaden the noise made by surplus water? M. B.

A covering of felt can be used for this purpose; but the manufacturers of the waterwheel can better advise you.

In suburban districts, where the streets are covered with trees, at what height above the street are incandescent lamps usually placed? M. L. J.

The practice varies. From 12 ft. to 15 ft. should give satisfactory results.

What effect, if any, will result from the operation of 60-cycle motors, meters, etc., on a circuit fed from a 66-cycle generator? L. C. McL.

Standard 60-cycle motors will operate on 66-cycle circuits with a proportionate increase in speed. Watt-hour meters will register the same on 66-cycle circuits as on 60-cycle circuits.

What solution is used in rectifiers having electrodes of aluminum and iron when connected to a 110-volt alternating-current circuit? S. A. H.

There are various solutions used in aluminum rectifiers. A neutral solution of ammonium phosphate gives good results, or a fused electrolyte of sodium nitrate may be used.

What town or city was the first to be lighted by electricity in the United States? C. C. R.

Series street arc lamps were used in Cleveland, Ohio, in 1879 and shortly afterward a central station was operated in San Francisco for feeding open arc lamps. The first incandescent lamps were supplied with energy from an Edison station in Pearl Street, New York, in September, 1882.

Can I, by placing collector rings on an armature shaft in addition to the commutator of a 110-volt, direct-current motor, obtain a two-phase alternating current while the motor is in operation? R. S. H.

By using four collector rings and tapping the armature at points 90 electrical degrees apart the machine becomes a two-phase rotary converter. The frequency in cycles per second will be equal to the product of the number of poles times the speed in r.p.m. divided by 120.

In rotary converters, what effect would variation in the exciting current have on the behavior of the machine? T. P. V.

When driven from the direct-current side the machine will increase in speed with a decrease in the exciting current. The increase in speed, however, will not produce a corresponding increase in voltage on the alternating-current side, because it is not more than enough to make up for the decrease in the strength of the field in which the armature rotates. When driven from the alternating-current side no change of speed can follow from an alteration in the exciting current since the machine must continue to run synchronously at a speed depending only on the frequency of the supply.

We have a 10-hp, 125-volt, four-pole, series-wound motor which we desire to change for a shunt-wound machine, and would be obliged for information on how to do it. A. E. & M. Co.

Measure the current taken by the field coils when the motor is operating at the required speed and has the normal voltage impressed upon it. By counting the number of turns in the field coils and having measured the amperes, the ampere-turns are readily found by multiplying the value of one by that of the other. It will be necessary for the shunt-field coils to have the same number of ampere-turns, and by allowing 1200 circ. mils per ampere, the proper size of wire may be found from a wire table.

Fan and blower builders are now offering complete lines of motor-driven exhaust fans. The motors are usually of the round or universal types, and I note that both shunt and series-wound motors are offered for this service. Since motors with shunt and series windings have entirely different characteristics, it seems that one or the other must be best adapted for the work. Are there different classes of exhaust service for which one type of motor is preferable to the other? C. W. D.

Motors driving steel plate blowers are usually shunt wound and where the load is fairly constant shunt-wound motors are generally installed. In exhaust fans the motor is usually direct-connected to the fan so that if a series motor is used the load cannot be suddenly lost and the motor speed up. Where the conditions of load are unknown, a series-wound motor is installed because such a motor will slow down if overloaded and speed up if underloaded, the tendency being to carry only a load suited to it; so that troubles from overload are not so liable to damage a series-wound exhaust fan as a shunt-wound exhaust fan.

In making service connections to buildings, what is the proper position for the cut-out and switch? S. J. F.

The proper location of the switch and cut-off will depend on conditions. The fuse must be placed as near as practicable to the place where the service connections enter the building, and the switch may be placed at some readily accessible place as near to the service entrance as possible. Thus, in an underground system, the fuse must be placed where the service entered in the basement or cellar and the switch might be placed on the floor above if that were the nearest readily accessible position. This is the spirit of the Code rules, the intent being that in case of fire, the service can be disconnected as quickly as possible. Where the point of entrance is readily accessible both the switch and cut-out would be placed there; but we can conceive of cases where the fuse would be placed at the service entrance in the attic and the switch, three floors below.

Kindly inform me if it is possible to obtain a three-phase, 220-volt secondary service by the use of two ordinary transformers of the 2200-220-volt type with a three-phase, three-wire primary. Three transformers are now being used to obtain this result. C. W. W.

Two transformers may be employed in three-phase transformation by using what is known as the T-connection. One transformer is connected across two of the line wires, while the other is joined between the third line wire and the middle point of the first transformer. The current in the primary coil of each transformer is the same in value as that in the primary coil of the other, and the secondary currents in the two transformers are likewise equal in value. The voltage impressed across one transformer is only 86.6 per cent of that across the other, so that if each transformer is designed especially for its work, one will have a rating of EI and the other a rating of $0.866\ EI$; where I is the current in each line wire, and E is the e.m.f. between lines. The combined rating will, therefore, be 1.866, as compared with $1.732\ EI$ for three single-phase transformers connected in delta or star. It is not essential that one transformer be designed for exactly 86.6 per cent of the voltage of the other; the normal voltage of one can be 90 per cent of the other, without producing detrimental results.

I note that the terms "current," "power" and "energy" are often used for one and the same thing, and I would be obliged if you will kindly state the difference between these terms and also between a "recording wattmeter" and an "integrating wattmeter." I am always more or less confused by these terms and would be glad to have the matter clearly explained to me. T. F. C.

Current is measured in amperes; electromotive force is measured in volts; power is measured in watts, and energy is measured in watt-hours. Unfortunately this distinction is not generally made by central station men and writers who know better. The terms "power" and "energy" have just as definite a significance as the terms "velocity" and "distance." Energy is the product of power and time, while distance is the product of velocity and time, and it is just as improper to use the term "power" where "energy" is intended as it is to use the term "velocity" where "distance" is meant. What is sold by electric light companies at — cents per kw-hour is electrical energy—not current or power, and this is measured by a watt-hour meter and not by a wattmeter of any description whatsoever. Although recording wattmeters (those equipped with charts) can be and have been built, it is physically impossible to construct an integrating (that is, adding) wattmeter to measure energy. The amount of energy used cannot be determined directly by means of a wattmeter; account must be taken of the time, and this fact gives rise to a unit of electrical energy—the watt second or joule. The term "time-meter" is equally as appropriate as the term "wattmeter" for an instrument which measures watt-hours.

Growth of Alternating Current in New York City.

By T. I. Jones.

NOTWITHSTANDING the general business depression that has marked all lines of trade during the past six months, the advance made in the use of alternating current electricity throughout the island of Manhattan has been most marked. The records of The United Electric Light & Power Company, which supplies the alternating current throughout this territory, shows during the past six months an increase in 16-cp equivalents of over 20 per cent.

Perhaps the largest increase which has been made in the general use of alternating current in New York City during the past year has been that of the National Biscuit Company, whose factory covers the entire block bounded by Ninth and Tenth Avenues and Fifteenth and Sixteenth Streets. This factory uses two-phase Westinghouse motors throughout for the operation of all its machinery, a detailed list of the motors in use being as follws:

No. of motors.	Size of motors.
1	150 hp
1	75 "
2	40 "
3	30 "
9	20 "
14	15 "
7	10 "
35	7½ "
28	5 "
12	3 "
10	2 "
15	1 "
25	½ "
12	⅛ "
Total...174	1,342½ "

In addition to this equipment freight and passenger elevators are in service, all operated by two-phase motors. Besides the motor applications in the National Biscuit Company's factory there are over 5000 incandescent carbon-filament lamps and 1500 Nernst glowers.

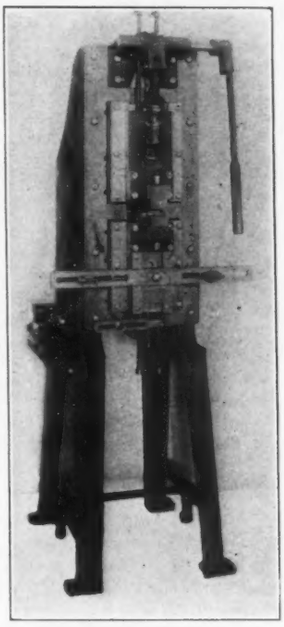


FIG. 1.—HAND SPOT-WELDING MACHINE.

When the Parker Building fire occurred at Fourth Avenue and Nineteenth Street, two months ago, it drove the Kny-Scherer Company (one of the largest manufacturers of surgical instruments in the United States) from its showroom and offices at that point to its factory building at the southwest corner of Ninth Avenue and Twenty-seventh Street. The entire two top lofts of the factory were fitted up for general offices and salesrooms, and the manufacturing equipment was remodelled.

Previous to the change in quarters the Kny-Scherer factory was run by a 150-hp Corliss steam engine, which was supplied with steam from three boilers of 75 horse-power each, consuming 3½ tons of coal per day. Connected to the engine by a belt was an old 75-kw Edison generator for the lights. This steam engine has been entirely shut down and the shafting of the factory split up and driven by seven individual-drive, two-phase General Electric motors. In addition to these motors a freight elevator driven by a 15-hp, two-phase motor has been installed. This plant has been in operation but 30 days, and during that period an economy of over 20 per cent has been shown over the steam power cost of operation and maintenance. In addition to the alternating-current motors in this building, it is lighted by metallized filament, arc and tungsten lamps. The complete installation consists of about 3000 16-cp equivalents.

Another installation which is just about to be installed, involving alternating-current power and lighting, is that of the Fleischman Bakery, which has taken the building formerly occupied by the McCreery dry goods store, Broadway and Eleventh Street. In this building the bakery will use two-phase General Electric motors in the dough-mixing and dish-washing machines, and in the ventilating apparatus. The firm of Ravitch Brothers, one of the largest structural steel contractors in the city, during the past year has had in constant operation 90 horse-power in motors.

The electric welding industry which was started in New York on a small scale in the latter part of 1906, has during the past six months enjoyed a material growth. The Universal Electric Welding Company has installed a number of new electric welding machines at its plant, 40 West Thirteenth Street, among which is an automatic spot-welding machine, recently shown at the New York Electrical Show, and now being manufactured on a commercial scale. An electric hand-welder is shown in Fig. 1. This machine taking from 5 to 10 kilowatts of current, hand fed, is capable of turning out welded material with from three to 15 times the speed of the old riveting method. The class of work which these machines do is shown in Fig. 2. All of the joints on the spouts, covers and handles of the vessels shown are made by the use of the spot-welding machine here shown, alternating current only being available for electric welding.

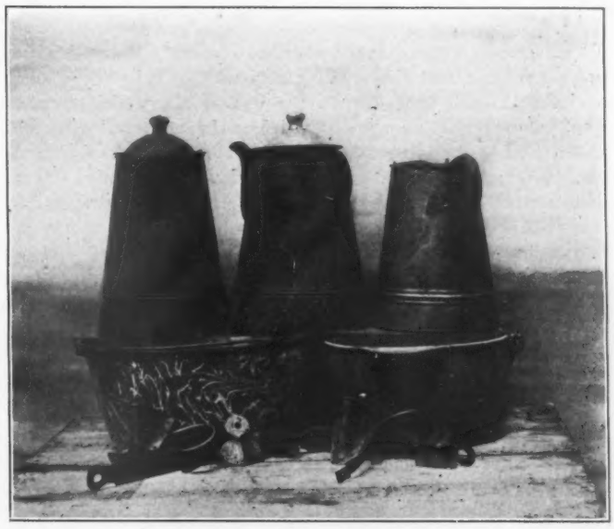


FIG. 2.—SAMPLES OF WELDED GOODS.

The method of razing buildings and structures having iron or steel pillars, by alternating current, which was first introduced in New York City in the demolition of the old Hoffman House (which method is illustrated in Fig. 3) will again be used in the removal of one of the largest structures in New York City during the coming summer. This method has for its object the melting of the base of the pillar by the use of current of great amperage through step-down transformers.

In connection with the building of the new subways with which the average New Yorker is at present interested, alternating current is playing a prominent part. Over 50 horse-power in two-phase alternating-current motors have already been contracted for with the United Company for the operation of concrete mixers to be used in connection with the building of the subway connecting the Williamsburg and Brooklyn Bridges. Electric hoists, of which the following picture shows a type, are also used in such subway work as this in many of the operations for the elevation and lowering of construction material and in dredging. The operation of two-phase motors, both on the concrete mixers and hoists, does away with the stationary boiler and necessary piping in connection with the

steam apparatus on the older constructions, and, taking as a basis, 10 lb. of coal per hp-hour, coal at $4 per ton, and current at 8 cents per kw-hour, the use of electric hoists nets a saving of 40 per cent in favor of electricity. The necessary readiness-to-serve on the steam mixers and hoists requires a constant consumption of coal for the operation of the steam engine, involving a cost not incident to electrical service from the street mains.

Perhaps the latest application of alternating-current motors in New York City is in the shoe-shining machinery of the West Moreland Automatic Shoe Cleaning Company, at the corner of Broadway and Thirty-ninth Street. In this place are 14 shoe-shining machines, each operated by a ½-hp single-phase motor. These machines have been in constant operation for the past three months and are giving general satisfaction, with little or no maintenance trouble.

The electric flashing sign which has become to be such a figure along the Great White Way in New York City owes much of its successful operation to the use of alternating current. The following list of signs, all lighted by alternating current and switched by alternating-current motors, bears evidence to this fact: Sparkling-water sign, Broadway, corner Thirty-fifth Street; El Bart gin-rickey sign, Broadway, southwest corner of Forty-second street; Victor talking-machine sign and moving-letter sign, Broadway, corner Thirty-seventh Street; "U-Need-A" biscuit sign, Eleventh Avenue and Sixteenth Street; Levey's waving-feather sign, Broadway and Forty-third Street; Levey "That Spot," 125th Street and Lenox Avenue.

This necessarily brief résumé of some of the applications of alternating current made in New York City during the past six months is meant to give only a general idea of the work that is being done in Manhattan Island alone. A very considerable amount of single- and two-phase motor work is being done in Brooklyn and the Bronx. The installations here cited, however, will, it is hoped, be sufficient to show the general attention which is now being given in New York to the application of electricity for business purposes, and the demand that is being made for alternating current.

FIG. 3.—METHOD OF RAZING HOFFMAN HOUSE.

Progress in Electric Heating.

By H. W. Hillman.

The installation and continued operation of 27 electric luminous radiators at the Eagle Hotel, Grand Rapids, Mich., has caused many conservative engineers to take an unusual amount of interest in the subject of electric heating. The installation has also caused enthusiastic admirers of electric heating to be proud of the progress which this branch of the industry has exhibited. Both classes of electrical men are naturally interested in the details of the installation, an outline of which is given below.

In the Eagle Hotel the conditions were particularly favorable for electric heating. While the steam-heating system was satisfactory for average conditions of weather, it was overtaxed during severely cold weather, and uneconomical during spring and fall seasons when a small amount of heat would take the chill off the rooms. The electric system, therefore, acts like a storage battery for a station, helping out at the peak of the "severest weather load." It offers excellent flexibility for the spring and fall season requirements for small amounts of heat.

The initial cost of the radiators to the Eagle Hotel was manufacturer's cost plus freight to Grand Rapids, or about $325. When considering an addition to the main steam-heating system, the small sum for the radiators was found satisfactory.

The cost of wiring amounted to about $90. Of course, an entirely new circuit was required, each radiator being properly fused, and the whole system of wiring approved by the local inspector as to size of wire, method of construction, etc. The wiring was done by a local contractor, M. B. Wheeler Company, and the cost of wiring, plus the initial cost of the radiators, was not prohibitive.

The Grand Rapids-Muskegon Power Company's rate for less than 25-hp. maximum demand is 3 cents, with a discount, making a net of 2.55 cents per hp-hour. Each radiator consumes one horse-power. The average conditions of the hotel trade indicate that only 10 or 15 of the rooms are occupied at a time, and the occupants would usually require heat for only about two hours in the morning and two hours in the evening. A few days in December were so mild that the radiators were not used either in the morning or evening.

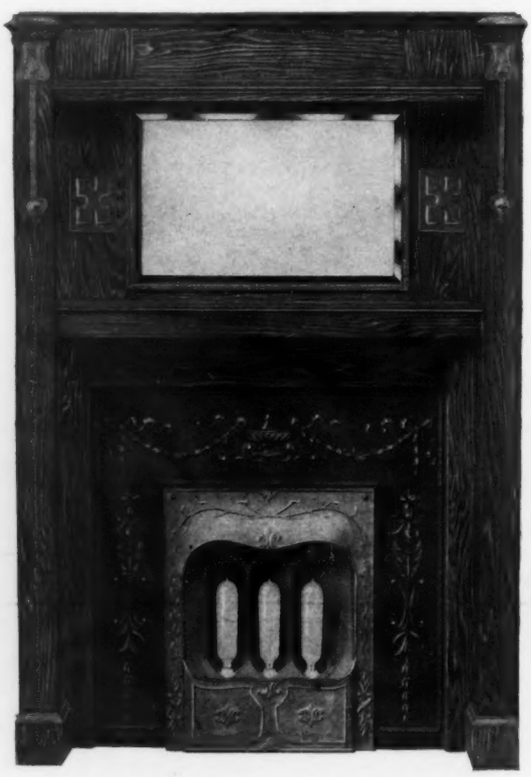


FIG. 1.—ELECTRIC GRATE AND MANTEL.

The energy used by the installation is metered. On the basis of an average of 10 radiators operating an average of four hours a day, including Sundays, 1200 hp-hours would be required, and the bill would be $30.60 for the month. The load will be permanent and with good business conditions the bill will vary for six months in the year between $20 and $40 per month, which is satisfactory to the power company.

The question arises as to why such business is satisfactory to the power company. It is understood that the customer purchases the radiators and pays for the wiring. The power company simply furnishes the energy and installs the meter in the same manner as it would handle a motor installation. The average income from such a heating installation will compare very favorably with that from motor installations of similar

size. As an answer to the argument opposing electric-heating installations because of the summer season and the absence of income for several months, it may be stated that many motors remain idle during the winter months.

On account of the favorable conditions as to climate, the simplicity of wiring, the reasonable initial cost of the radiators, the encouragement of the Georgia Electric Light & Railway Company, and the operating experience at the Eagle Hotel, an installation will probably be made in a hospital at Atlanta.

Both the conservative and the enthusiastic electrical engineer will be interested to know that the Rathbone & Panigot Mantel Company, of Grand Rapids, has established an electrical department in connection with its mantel business. For years the company has manufactured and sold gas mantels, and is well known in that class of business. Since the last fall season that company has thoroughly investigated electric luminous radiators, and recently begun the manufacture of electric grates.

Fig. 1 shows the general appearance of one of the grates. Its design is particularly artistic. In appearance it harmonizes with other decorations and appointments in the room so that it is easily adapted to installation in residences already erected. As to size and shape, it will fit any mantel, so that a coal grate or gas grate could be readily changed for an electric grate. As

FIG. 2.—ELECTRIC GRATES IN A GRAND RAPIDS MANTEL FACTORY.

to efficiency, it is so designed that no heat passes "up the chimney." The heat is radiated and heated air is circulated in the room, and the grate, therefore, possesses a higher efficiency than any other heating device.

The instantaneous heating feature of the electric grate is advantageous. The gas grate likewise responds immediately after lighting, but it possesses the bad feature of vitiating the air in the room. This point gives the electric grate a decided advantage. It was the many advantages of the electric grate which led the Rathbone-Panigot Company to take up its manufacture aggressively. Its long experience in the manufacture and sale of gas grates adds weight to its opinion as to the value of the electric grate.

From the standpoint of the residence customer the electric luminous radiator is becoming a necessity. In a large house recently erected in Grand Rapids five radiators were installed for bath-room use. They were connected to a separate meter circuit.

In the exhibition window of every supply contractor in Grand Rapids electric radiators are in evidence. In the wiring of new and old residences, large and small, plans are made for at least one radiator. The excellent work which has been done by local supply dealers in promoting this electric heating business will be further stimulated when the furniture dealers commence to exhibit electric grates in connection with their various styles of mantels. The Young & Chaffee Furniture Dealer, of Grand Rapids, which is an agent for the Rathbone-Panigot Company, has ordered six electric grates for exhibition in its salesroom with mantels, in the same manner as it has exhibited gas grates in the past. The design of this new grate especially fitted for mantels associates the use of this electric device closely with the furniture dealer, and it extends the field for exhibiting the electrical heating devices. People who visit this large wholesale furniture house will at least see the electric grate in operation.

The most popular grate or radiator is the one rated at 750 watts. At the rate of 3 cents per hp-hour the cost of operation per hour is 3 cents. An owner of an average-size residence who had a bill in January of about $8 for lighting would have objected to a bill of $10 for light, but he gladly paid $2 for the use of a luminous radiator. He considers this device an indispensable fixture in his house.

Central-station managers in general are familiar with the price of luminous radiators and will be glad to know that the price of the electric grate is only slightly higher than the radiator. It is competitive in price with gas grates. There are many reasons why each and every central station should promote the heating business. The progress of electric heating is rapidly advancing, while the approaching spring season will show a greater advancement than any previous year. An additional business, such as intermittent electric heating, will assist in building up of the summer load.

Progressive Central-Station Advertising at Birmingham.

The Birmingham Railway, Light & Power Company publishes a four-page weekly folder called *The Illuminator,* and besides maintaining an attractive exhibit of new electrical appliances at its main office, advertises quite extensively in the newspapers of the city. *The Illuminator* is a 5-in. x 6-in. folder which is distributed free of charge in the cars to the public, and theatrical notices are also included in its make-up. Among the topics which the periodical takes up are places of interest in the city, the opening of new transit facilities, car schedules, transfers, changes in meter-reading periods, new apparatus of special interest, and announcements to consumers. Six volumes of these folders have now been issued, and they are all specially prepared with the local needs of Birmingham in view, rather than being filled up with matter duplicated in many other cities. New industrial opportunities are also touched upon in this folder at times.

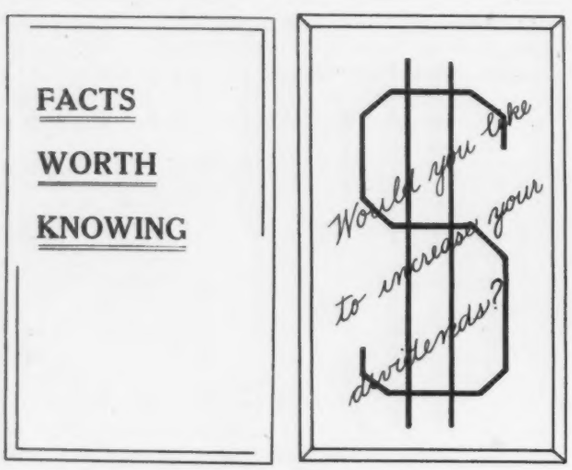
In common with many other companies, the Birmingham organization has found it desirable to give space to the subject of meter reading. In a recent newspaper advertisement, 13 in. long and 6.5 in. wide, the company illustrated a meter dial and explained with care the way to read meters, pointing out that there is no mystery in the task, although consumers are often of that opinion. The method of figuring monthly bills was also explained. In addition, the company stated that a meter in a house can be tested easily as follows: "A 16-cp incandescent lamp consumes about one-eighteenth of a kilowatt per hour. In the evening let the consumer read his meter, then light 18 16-cp lamps for one hour, or six lamps for three hours, and at the end of the time read his meter again. The electricity consumed, if the meter is recording properly, is then 1 kw-hour, making a difference of one figure on the right-hand dial of the meter." To enable the consumer to get a rough idea of the kw-hour, it was stated that this would keep an arc lamp burning about two hours, would run a 1-hp motor at full load one hour and 20 minutes, would run a fan all day, or a sewing machine all day, and it would also keep a small iron hot for three hours or a large one hot for two hours. In bringing the subject to the attention of its customers in this way, the company endeavors to lessen the chances of friction over meter readings, and thus is constantly strengthening its position.

Central-Station Publicity.

By Norman G. Meade.

A JUDICIOUS distribution by central-station companies of neatly executed literature describing the advantages of motor drive and the convenience of popular applications is very desirable. Small pamphlets, envelope size, are the most convenient, as they may be mailed with monthly statements to customers, making a saving in postage. The class of literature mailed to customers should be descriptive of new devices with a statement of their salient features. These folders are also suitable for the general mailing list, as the installation of some one appliance for a new customer establishes a foothold which generally leads to an extension of business.

If the central station is located in a city where there are numerous large industries operating private plants, a folder setting forth the reasons why electricity should be purchased from light and power companies should be mailed to managers or superintendents. Such folders can be artistically got up and be of a nature to attract attention, or, in other words, be of the "anti-waste basket" type. Figs. 1 and 2 are suggestions for cover designs. The folder should contain an introduction, calling attention to the economy of using purchased electricity and an explanation showing why central stations can sell electrical energy cheaper than it can be generated in private



FIGS. 1 AND 2.—COVER DESIGNS.

plants. This introduction should be followed by specific reasons for purchasing energy similar to the following arguments:

1. Power is always instantly available, day, night or Sunday. 2 A few machines may be operated, consuming energy only when in use, thereby eliminating operating expenses in boiler and engine room. 3. The expense of removing ashes and refuse from the power plant, with the attendant dirt, is eliminated. 4. Delays and shut-downs incident to accidents in the power plant are eliminated. 5. Power is always available regardless of strikes and labor troubles. 6. Fire hazards are reduced by the elimination of the power plant and high-pressure steam boilers. 7. Space occupied by the power plant is made available for manufacturing or storage purposes. 8. Ground necessary for coal storage is made available for extensions or new buildings. 9. Power for overtime and repair work is always available without the expense of operating a power plant. 10. Noise, smoke and dust incident to the operation of power plants are eliminated. 11. In warm weather the heat arising from the boiler and engine room is eliminated. 12. The cost of ventilating systems is reduced. 13. The accounting department is relieved of numerous entries for fuel, oil and incidental supplies. 14. An estimate of the cost of energy for any ensuing period of time can be made, as a uniform rate is obtained regardless of the market price of fuel. 15. Better regulation is maintained on the distribution system supplied by the central station, insuring a uniformity of speed of the motors, which increases the output. 16. Extensions can be made at any time by simply running a few additional circuits. 17. The responsibility for continuous service and uniform voltage rests with the central station. 18. The superintendent or manager is relieved of the duty of overseeing the operation of the power plant, thus leaving more time for routine work. 19. The difficulty of obtaining competent firemen and engineers is eliminated. 20. The annual expense for energy will be reduced materially.

Another form of advertising literature, mailing cards, is shown in Figs. 3 and 4. In Fig. 3 the card is shown folded for

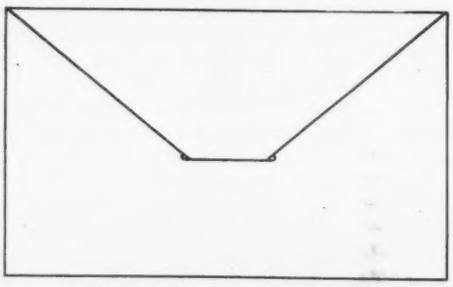


FIG. 3.—MAILING CARD FOLDED.

mailing, and in Fig. 4 open for reading. This form of card is very good for follow-up work. It can be sent out at frequent intervals after the folders have been distributed, and should contain pertinent facts and give descriptions of new devices. These cards will necessarily have to be classified the same as the folders, for residence, business and manufacturing distribution.

A house organ is by far the most desirable form of advertising, and if conducted in an interesting manner will be looked for and generally read. It should contain descriptions of new applications, late engineering news of popular interest, arguments in favor of the use of electricity, short descriptions of new installations connected with the company's service and any notes of general interest. An excellent feature of such a house organ is a page devoted to practical suggestions for the care, management and repair of motors, with instructions for locating faults, etc. The success of any advertising medium lies in creating a demand for it. This can be accomplished by catering to the wants of the people and giving them material of practical value.

Fig. 5 is a suggestion for a cover design. The illustration should be changed for each issue, showing some new installation or appliance. If necessary the expense of publishing such a paper can be largely defrayed by the advertisements of local merchants. A well-got up paper, gratuitously distributed, is

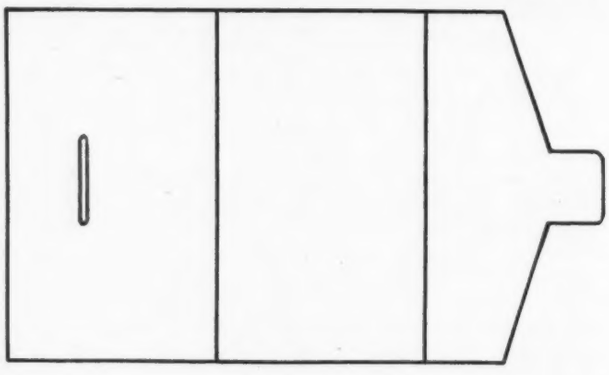


FIG. 4.—MAILING CARD OPEN.

a good advertising medium for business men in general, and central stations should have no trouble in selling enough space to cover the cost of publishing.

The first page of the initial issue should be devoted to an editorial announcement expressed somewhat as follows:

TO OUR FRIENDS AND CUSTOMERS.

In presenting this, the initial issue of *Current Events*, we sincerely hope that our efforts will be appreciated. It is our aim to incorporate material

in the columns of each issue that will be of value to the readers and keep them in touch with the latest developments in the electrical field, also to make practical suggestions for the maintenance of motors and appliances of our customers.

The layman does not, as a rule, follow the electrical papers and fails to keep abreast of the many developments in electrical appliances and labor-saving devices for household, business and manufacturing purposes. We intend to tell you all about such applications and show you where you can save money and increase your output by adopting electricity.

There are innumerable devices for use in residences, mercantile establishments, hotels, restaurants, banks, and, in fact, every walk of life that will add to comfort and safety and economy, in addition to saving labor and expense. In the bank, for instance, there are now in general use numerous devices operated by electric motors which automatically perform work formerly done by hand. In this field one of the most important applications is the coin-counting machine, which automatically counts and wraps coins of various denominations. There are other electrically operated devices as well, including addressing machines, letter openers, envelope sealers, etc.

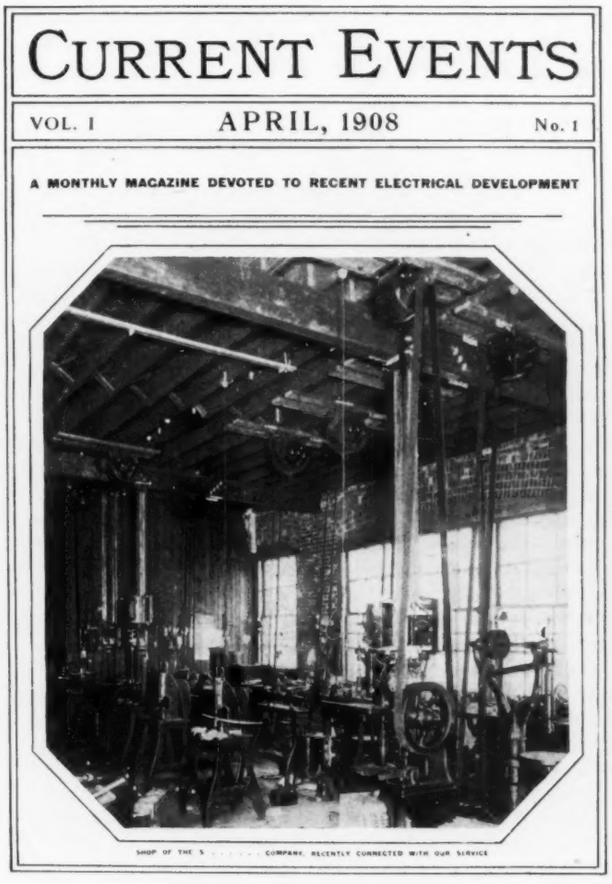


FIG. 5.—COVER DESIGN.

At the present time the large bakeries are using machinery wherever possible and electric motors are coming into extensive use for its operation. Nowhere is cleanliness more essential than in bakeries, and individual drive by electric motors fulfills every requirement, obviating the use of belting and shafting with the ever-present dust and dripping oil.

Not alone in ordinary business and private pursuits do we find openings for electric power; amusement parks, theaters and concert halls provide many applications. An amusement park where people go for recreation should be free from unsightly objects and anything that mars the general effect of the architecture or scenery. In everyday business life there is much that is disagreeable in the way of dirt and noise, and to secure relaxation it is obvious that places of pleasure should be free from such annoyances, consequently the steam and gas engines that were formerly used for the operation of various devices have given way to the electric motor. What could be more annoying than when listening to a concert or opera than the constant detonations of a gas engine or escaping steam? By using electric motors noise and soot and dirt are eliminated.

To mention all the possible opportunities for the use of electric motors would be beyond the scope of this page. It is sufficient to say in closing that wherever power is required the electric motor offers every inducement for its adoption.

The exact contents of a house organ cannot be laid down, as local conditions will govern its makeup to some extent. The pages are always enlivened by illustrations. Electrotypes of various appliances are readily loaned by manufacturers for the publicity they will receive through its circulation. Small notices of new customers interspersed in the reading columns, something like the following item, are generally interesting:

GAS AGAIN SUCCUMBS TO ELECTRICITY.

The machine shop of ———— ————, illustrated in Fig. 6, has recently been equipped with motor drive. This is another of the many instances where the gas engine has been superseded by electric motors. This shop is devoted to custom work and the adoption of electric drive is another evidence of the progressiveness of Mr. ————, the proprietor.

Various other items calling the attention of manufacturing companies to the advantages of electric drive will be of interest.

A page made up of operating hints should contain practical suggestions based on the company's own experience. Information on the care and maintenance of electric motors may be found in many books devoted to the subject and in the technical press. The regular electrical papers contain abundant items of interest which may be reprinted in full if proper credit be given, or the facts only may be taken and used in connection with some other item bearing on the same subject. In this way it is an easy matter to fill the paper with items of real, live interest and to educate the community in electrical matters. Small central-station companies cannot hope to emulate the example of the very large companies, whose bulletins cost very much to publish. Less elaborate bulletins cost considerably less, and if monthly publication is not considered feasible, quarterly numbers may be issued. It has been found that, as a general rule, with the education of the public in things electrical has come increased load and increased profit.

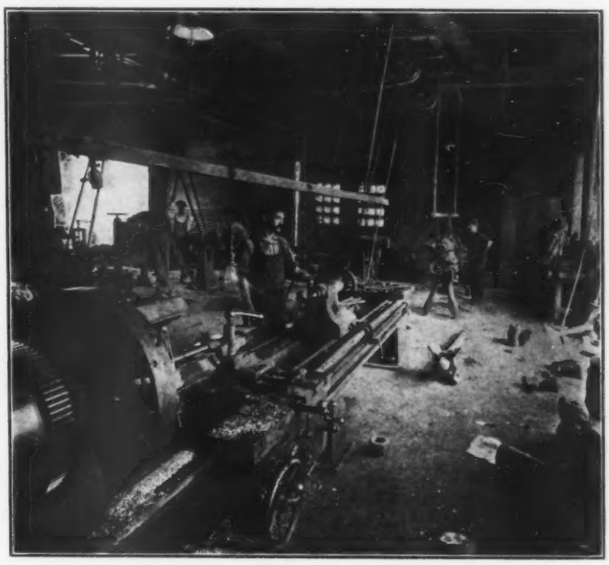


FIG. 6.—EXAMPLE ILLUSTRATION.

A Record on Washing-Machine Motors.

Mr. Adolph Wagner, superintendent of the municipal electric lighting plant at New Ulm, Minn., a town of 5720 population, has made a remarkable record in introducing washing-machine motors in his city. He has 50 such motors in service. They are mainly ⅛ horse-power of Emerson manufacture. Various makes of machines are used. This record is all the more remarkable because municipal plants do not have the reputation of pushing for business and introducing new appliances as do companies. Most companies have as yet introduced very few washing-machine motors. It would be interesting to learn from our readers whether any company or municipal plant has equaled this record of approximately a washing-machine motor for every 114 inhabitants. Most of the washing machines in use in New Ulm are of the less expensive kinds, so that the total cost of motor and machine is under $30.

Broadway's Latest Sign.

The accompanying cut illustrates the latest striking sign along Broadway, New York. The sign is on the southwest corner of Forty-second Street and has been named by the builders, the O. J. Gude Company, the "Largest Petticoat in the World." An appreciation of the size of the sign may be had from the

ELECTRIC SIGN ON BROADWAY, NEW YORK.

following figures: Length of skirt, 70 ft.; width of "Heatherbloom," 50 ft.; length of shoe, 12 ft.; width of buckles, 3 ft.; height of sign, 55 ft.; electric lamps in sign, 1867.

It has been remarked that the signs along Broadway heretofore have generally appealed to one's thirst rather than to one's apparel. The forerunners of this sign have alluded to champagne, gin, cognac, Scotch whisky and the like. This sign is the first to make a departure and to advertise clothing. Current to this sign is supplied from the alternating-current mains of the United Electric Light & Power Company.

"New Business" Campaign in Cincinnati.

In a letter to the stockholders, President Kenan, of the Union Gas & Electric Company, of Cincinnati, Ohio, gives the following as the partial result of an aggressive "new business" campaign: During the year 14,984 gas meters were added to the service and 3,069 electric meters were installed in addition to those already in use. Sixteen private gasoline-electric generating plants were closed down, 44 steam and 34 isolated generating plants were supplanted by the service, while 37 hydraulic elevators were changed to electric power. The newspaper and circular part of the work was in charge of Mr. Walter L. Byron.

Letter to the Editors.

Noisy Operation of Dynamos.

To the Editors of Electrical World:

Sirs:—In connection with Prof. Nathaniel R. Craighill's article on "Noisy Operation of Dynamos," which appeared in the issue of Feb. 1, it may be of interest to note that a very similar article by Mr. J. Fischer-Hinnen appeared in the *Zeitschrift für Elektrotechnik* (Vienna), June 5, 1904. In that article Mr. Fischer-Hinnen arrives at the same conclusion as Professor Craighill, namely, that for quiet running the ratio of pole-arc to pitch of armature slots should equal an integer $+\frac{1}{2}$, but states that it cannot be considered absolutely accurate since it does not take into consideration the width of the slots. He also states that "in several machines the air-gap was considerably decreased without perceptibly increasing the noise, although the opposite would generally have been expected." The results of 25 tests showed the agreement of the theory with the results obtained in practice except in the case of machines having a large number of armature slots.

The writer has corrected noisy machines in a number of cases by applying the above formula and calculating the length of pole-arc for quiet running, and believes that the probability of noise should be considered when designing direct-current machines.

Since induction motors sometimes prove unaccountably noisy, it seems possible that experiment might lead to a similar formula applicable to that class of machinery.

Denver, Col. E. N. Jennison.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Transformers.—E. Elm.—An illustrated mathematical article describing the method of calculating the dimensions of a transformer so that its cost of manufacturing is a minimum for a given efficiency and a given temperature limit.—*Elek. Zeit.*, March 5.

Lamps and Lighting.

Small Transformers for Metallic-Filament Lamps.—An illustrated article describing a number of small transformer designs of various British companies for use with low-voltage metallic-filament lamps. The autotransformer design seems to be generally preferred, and it is pointed out that it is advantageous wherever possible to adopt a distributing secondary pressure exactly one-half or one-third of the supply pressure and connect the transformer as a balancer with the equivalent of a three-wire or four-wire distribution system. In installing transformers for this purpose, two different methods of distribution may be adopted: (1) One transformer may be used for each lamp or ground of lamps which are required to burn always together, so that the transformer and the lamps it supplies may be switched on or off together; or, (2) one transformer may be used for a whole installation, the transformer being switched out when no lamps are required. In the first system the initial cost of transformers is greatest; the advantages are, however, that the installation wiring has to carry current corresponding to the normal circuit voltage instead of the reduced lamp voltage, and that no losses occur in the transformer when the lamps it supplies are not in use. Further, the transformer is always operating at full load corresponding to its highest efficiency. The second system has the advantage of lower first cost of transformers; on the other hand, the installation wiring must be suitable for carrying the current corresponding to the reduced voltage, and when only a few lamps are in use, the transformer will not be working at its highest efficiency. In arranging installations, therefore, it may often be found advisable to adopt a combination of these two systems. A special design of transformers for the first of the above systems of distribution is shown in Fig. 1. Concerning a type of transformers for the second of the above systems of distribution, the following figures are given which show the advantage of arranging the transformer as a balancer and grouping the load as evenly as possible on both sides. These figures relate to a 200- to 100-volt transformer for 18 amperes 75 cycles with a

constant iron loss of 10 watts connected as a balancer. If 18 amperes are on one side and nothing on the other, the total loss is 41 watts. If 18 amperes are on one side and 9 on the other, the loss is 18 watts. If 10 amperes are on one side and 8 on the other, the loss is 10½ watts. If 18 amperes are on each side, the loss is 10 watts. The voltage on the heavier loaded side is in these four cases 98½, 99¼, 100 and 100 volts, respectively. With regard to the arrangement of existing 200-volt installations for these transformers, where the system of wiring permits of its being divided into two or more bunches,

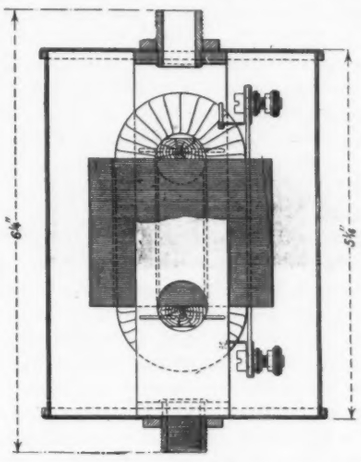


FIG. 1.—SECTION OF SMALL TRANSFORMER.

of approximately equal current requirements, as, for instance, when supplied from a distribution board, the method shown in Fig. 2 may be adopted. Where a distribution board is used, this involves only the cutting of one busbar, and the removal of one main from the uncut busbar to the half of the busbar divided from the other main by the cut, in addition to joining in the transformer shown. When this system is used, only the difference between the current taken by the two halves of the busbar passes through the transformer, and when these are balanced the only loss is the extremely small exciting current taken by the transformer. There is a further small loss in the transformer when the currents of the two halves are not

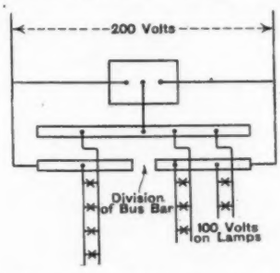


FIG. 2.—ARRANGEMENT OF WIRING OF AUTO-TRANSFORMER FOR BALANCED CIRCUITS.

equal, but this is only on while the currents are out of balance, and is almost negligible unless the two halves are much out of balance.—Lond. *Elec. Eng'ing,* March 5.

Metallic-Filament Lamp.—The International Electric Company, of London, advertises the "Orieco" metallic-filament lamp for which the following claims are made: The specific power consumption is 1¼ watts per British candle-power. It can be used on direct or alternating current. "The filament is made by a special process. Its initial cost will be compensated for by a saving of current after 200 hours' burning." The average life is given as 1000 hours, and it is stated that the efficiency does not fall off during the whole life.—Lond. *Elec. Eng'ing,* Feb. 27.

Carbon-Mercury Incandescent Lamp.—An account of a mercury-vapor lamp in which it is claimed the greenish color is corrected by the use of a carbon filament. The filament is enclosed in a U-tube, which also contains a little mercury. This is, however, only visible when the lamp is cold, for when the lamp is heated the mercury vaporizes and takes part in the phenomena. Although the power consumption is not perceptibly increased by the mercury coming into action, the illumination is stated to be considerably augmented. All the mercury is gradually converted into vapor by the heat from the lamp filament. This reduces the temperature of the filament somewhat, hence its resistance increases a little, and, therefore, the consumption decreases as the lamp becomes full of mercury vapor. This then carries a part of the current, and the filament is brought in time to red heat, thus supplying the necessary color correction.—From *L'Ellettricita*; abstracted in Lond. *Elec.*, Feb. 28.

Measuring Instrument for Incandescent Lamps.—An illustrated description of a measuring instrument of German make which gives not only the amperes and watts, but also the cost of energy per hour. The instrument, therefore, has three different scales. The scale giving the cost per hour must, of course, be calibrated differently according to the local rate per kw-hour. Also the watt scale must be calibrated according to the local voltage supply. The instrument is intended chiefly for use of laymen, so that they can read directly the cost of using a lamp for an hour and do not need to calculate it from the amperes.—*Zeit, f. Beleucht.*, Feb. 20.

Interior Arc Lighting.—A note on a large number of open inverted arc-lamps recently installed for interior illumination in the premises of a large London drapery establishment. The lamps are fitted with under-reflectors, and in some cases with over-reflectors. The useful intensity of illumination is about 3½ candle-feet.—Lond. *Elec. Eng'ing,* Feb. 27.

Traction.

Italian Power Transmission.—The conclusion of the illustrated description of the power transmission from Caffaro to Brescia. In the present instalment, the transformer station at Brescia and the converter station at the caustic soda factory in Brescia, where direct current is used for electrolysis, are described.—Lond. *Elec.*, Feb. 21.

Power Plant.—An illustrated description of the new electric-power station at the First Garden City. The plant consists of two gas-driven dynamos, each of 100 horse-power, supplied with gas from two suction gas plants, anthracite being the fuel. The dynamo gives direct current at 500 to 550 volts, and a battery and a balancer set are also provided. Supply is given to the factories at either 480 or 240 volts for power, and 240 volts for lighting.—Lond. *Elec. Eng'ing,* Feb. 20.

Cost of Electric Power.—In the discussion of J. F. C. Snell's paper on the cost of power supply for industrial purposes, several figures of the costs of power at private plants were quoted. Stothert stated that the cost of electric power at Babcock & Wilcox's Renfrew works was 0.9 cent per kw-hour, including an allowance for depreciation. Newington gave a case in which the cost of running a suction-gas plant came to 2.26 cents per kw-hour (including all capital charges, but not rent) as against 2.4 cents charged by the corporation previously. J. A. Robertson pointed out that the total cost of electric energy in a shipyard, whether the energy was bought or from a private plant, came to be a small percentage of the wages bill; in a particular case in Greenock the wages came to $675,000 annually and the power only $20,000.—Lond. *Elec. Eng'ing,* Feb. 20. In the discussion of the same paper at Sheffield, further figures were given by various speakers. Felden said that in spite of the price of gas at Sheffield being about half the figure upon which Snell based his comparisons, the Corporation were adding to their power load at the rate of 200 to 300 kilowatts per week. Works that had previously put down their own suction and producer plants had changed over to the Corporation, and the load factor at which they supplied was now from 40 to 45 per cent. Dickinson gave the diversity factor at Leeds as 2.4—Lond. *Elec. Eng'ing,* Feb. 27.

Electric Cranes.—H. H. Broughton.—A continuation of his very long illustrated serial on electric cranes. In the present instalment the author deals with motor-control systems. In order to take full advantage of the properties of an electric

motor it is necessary to consider carefully the systems of control to be adopted in any given case. In the first part of the article the several systems in vogue for controlling derricking, slewing, traversing and traveling motors are described. The most suitable arrangements for hoisting-motor controllers are then dealt with, and different methods of control are given. For the heaviest equipments it is necessary to use the remote-control system, and the author describes the elementary principles of this method. The control of single-phase compensated repulsion motors is next dealt with, and two methods of controlling three-phase induction motors are given in conclusion.—Lond. *Elec.*, Feb. 21.

Electric Drive for Wood-Working Machinery.—J. P. Judge.—An illustrated article on the recent equipment of a wood-mantel factory with electric power. Forty-five motors, aggregating 398 horse-power, have been installed, all of them being 230-volt, direct-current machines. A characteristic of many wood-working machines is that the speed of the cutting tool remains constant while the feed should be varied in accordance with the work being done. In such cases the machines are fitted with constant-speed motors for the cutting tools and with variable-speed-motor controllers for the feed.—*Gen. Elec. Rev.*, March.

Electric Power in Docks.—C. E. Taylor.—An illustrated paper read before the (British) Inst. Elec. Eng., in which the author described the many uses to which electric machinery has been put in connection with dock work, such as coal conveyors, hoists, wharf cranes, capstans, etc., and also for driving hydraulic pumping machinery. Parts of the machinery used at several large docks are given.—Lond. *Elec.*, Feb. 21; a full account of the discussion which followed the reading of the paper in Lond. *Elec. Eng'ing*, Feb. 27.

Feed-water Heating.—S. A. Reeve.—An article suggesting a new method for feed-water heating for power plants, with criticisms by R. P. Bolton.—*Eng'ing Mag.*, March.

Installations, Systems and Appliances.

Switzerland.—A continuation of the long article on technical details of hydro-electric installations in Switzerland. The author compares the different methods of electric power transmission and concludes that the three-phase system is preferable to the direct-current series system for transmitting energy from a power house to centers of distribution if the distance is short enough to transmit energy directly at the voltage generated in the power house, so that no step-up transformers are required. This is the case in most installations in cities. If, however, the distance increases and the tension to be adopted becomes very high, the direct-current series system may become preferable, as in the transmission system from Saint Maurice to Lausanne. In a large number of cases both systems are about equivalent and the three-phase systems will then probably be preferred on account of lower first cost. For transmission over very long distances, and especially into rural districts comprising a great number of centers of distribution of smaller importance, the direct-current series system appears to have decided advantages over the three-phase system. For traction on long lines, the single-phase system at 15,000 or 20,000 volts appears to have a promising future.—*L'Ind. Elec.*, March 10.

Electric Equipment of Ships.—W. D. Kirkpatrick.—A paper read before the Liverpool Eng'ing Soc. The chief difficulty of the use of electrical machinery on board ship is the effect on the compasses. To overcome this difficulty, the ironclad dynamo was introduced in 1895 and largely used by the British Admiralty, but the fact that its total weight is 60 per cent higher has led to the adoption of the open-type four- or six-pole machine, which combines a minimum of external leakage with a maximum of accessibility of the brush holders, and is at the same time self-ventilating. The usual insulated two-wire system is now generally used on board ship. In the British navy only vulcanized rubber lead-covered cables are used, run on teak battens fixed to the bulkhead, and secured by brass clips. In some other navies, notably that of Japan, the cables and wires are attached directly to the bulkheads, without teak backing being used. This method the author considers preferable. The standard voltages for ship work are much lower than those in use for shore purposes, and it is only within very recent years that 100 volts has been exceeded or, indeed, become general. Instead of a large number of auxiliary engines scattered all over the ship, the use of electric motors is far more economical. The modern traction motor is very suitable for all requirements on board ship. While electric installation is higher in first cost, the saving in fuel is considerable. A description of the electric plant on the new Cunard steamers *Lusitania* and *Mauretania* is given.—Lond. *Elec. Eng'ing*, Feb. 27.

Electric Power in Theater.—A description of an electrically-driven scene-shifting equipment recently installed at an English theater. A single motor is employed, which drives a long shaft at a constant speed. The separate winding drums by which the cloths, etc., are raised and lowered, derive their motion from this shaft by an arrangement of clutches and gearing.—Lond. *Elec. Eng'ing*, Feb. 20.

British Refuse Destructor and Electricity Works.—An illustrated description of the new combined refuse destructor and electricity works in Greenock which embodies some new features in destructor design, among which is a device for automatically opening and closing the charging door of the destructor furnace—so that the charging is accomplished without manual labor and with an absence of dust—and a well-designed system for supplying the furnaces with forced draught and ventilating the clinkering floor. The new works contains coal-fed boilers as well as destructor boilers; at present the plant capacity is 1500 kilowatts, and the station, which will eventually supply the greater part of the load at Greenock, is capable of considerable extension.—Lond. *Elec. Eng'ing*, Feb. 20.

London.—Some notes on important progress made last year in electric supply in London. For instance, the St. James & Pall Mall Electric Light Company has obtained a 10 per cent increase in its output and also a 10 per cent increase in its connections. There has been a very marked increase in the use of electric energy for industrial power.—Lond. *Elec.*, Feb. 21.

Slot Meters.—J. B. Clarke.—An article pointing out that frequently consumers when installing only a few electric lamps in a shop or residence do not realize that under existing English conditions their electricity account might be less if registered by a prepayment slot-meter than by an ordinary meter, even if the electricity is charged 1 cent per kw-hour more by the slot meter. The reason is that rent is charged for ordinary meters, but not for slot meters.—Lond. *Elec. Rev.*, Feb. 21.

Protective Devices.—An account of the discussion at the Dublin local section of J. S. Peck's recent paper on protective devices for high-tension circuits. Experience in dealing with voltage surgings in lines of various descriptions were given by central-station, tramway and telephone engineers.—Lond. *Elec. Eng'ing*, Feb. 20.

Circuit-Breakers.—Henry.—An illustrated description of high-tension circuit-breakers built by the Alioth Company.—*L'Ind. Elec.*, March 10.

Direct-Current Time-Limit Relays.—An illustrated description of direct-current relays recently installed on the main switchboards of the steamships *Lusitania* and *Mauretania*. It is pointed out that the only way a reliably inverse-time limit can be attained which can be adjusted independently of the current adjustment is by means of a separate relay.—Lond. *Elec. Eng'ing*, Feb. 28.

Curve Sheets.—J. B. Morgan.—An illustrated article describing a handy curve sheet for use of central-station engineers on which are to be plotted all the costs and output.—Lond. *Elec. Rev.*, Feb. 28.

Wires, Wiring and Conduits.

Steel-Tower Transmission Line.—In a transmission line in the southeast of Sweden a deep inlet of the sea had to be bridged over. Steel towers of special construction are used on either side of the inlet, the span between them being 735 ft.

The towers are 70 ft. high and the minimum height of the cable over the water is 130 ft. The conductors for this portion of the line are of stranded steel wire of 60 sq. mm. (0.093 sq. in.) in section, corresponding to copper wires of 7 sq. mm. section. There are four conductors, three in use, and one as reserve. The mechanical construction of the towers is described. "The tension in the cable at a temperature of — 30 deg. C. amounts to 600 kg (1320 lb.) between the towers, and 750 kg (1650 lb.) between towers and anchors. The maximum tensile stress in the cable is thus 12.5 kg per square millimeter (17,800 lb. per square inch), which provides a safety factor of 5. At + 30 deg. C. the maximum sag is about 30 ft. There is, however, no danger of the cables touching one another, as they are supported at different heights, and 6.5 ft. apart."—Lond. *Elec. Eng'ing,* Feb. 20.

Faults in Multicore Cables.—A discussion of the principal reasons which may cause faults on multi-conductor high-tension cables, especially short-circuits between two phases or interruptions in one or several phases. Methods for locating the faults are described.—*Elek. Anz.,* Feb. 6.

Wiring in Mines.—F. A. Barron.—A continuation of his notes on wiring and wiring supplies for mining service. He deals especially with porcelain or glass insulators, lamp sockets, lamp guards for portable lamps, individual controlling panels for alternating-current motors and trolley construction for mining locomotives. The total cost of 1000 ft. of trolley construction in coal mines, including rail bonds, is estimated at $197.—*Gen. Elec. Rev.,* March.

Wiring.—An article pointing out that if wiring is undertaken in conjunction with a small central station, careful organization and watching are necessary. The work divides up into four main classes, consisting of new wiring, work repairs to existing wiring, wiring extensions to old work, and attention to consumers' complaints. The author deals particularly with the manner in which the work should be booked and the various repairs entered up.—Lond. *Elec. Eng'ing,* Feb. 20.

Fuses.—An illustrated description of several constructions of fuses.—*Elek. u. Masch. Betr.,* Jan. 20.

Electrophysics and Magnetism.

Selenium.—C. Ries.—An account of an extended experimental investigation. The author first discusses the change of resistance of solid crystalline selenium cells due to illumination, and compares different methods of preparing them. He recommends to prepare the selenium first in the amorphous state and then change it by repeated heating into the crystalline modification; it is slowly to be heated up to 195 deg. C., maintained for about half an hour at this temperature, and then quickly cooled. He then discusses the production of an e.m.f. in a photoelectric cell. He finds that the photoelectric current always flows in the direction of the light rays; that is, from the dark selenium electrode through the liquid to the illuminated selenium electrode. If this cell is polarized by impressing an e.m.f. the photoelectric effect may be increased or diminished, or even annihilated. When the illuminated electrode was connected to the positive pole, weak polarization increases the effect considerably, while strong polarization is liable to decrease it. If, however, the illuminated electrode is connected with the negative pole, the photoelectric effect is diminished even by weak polarization and is finally completely annihilated. The polarization, therefore, has an influence not on the direction, but on the intensity of the photoelectric current. This opens up a new way for making selenium cells of high sensitiveness by employing a suitable polarization e.m.f. by a proper choice of the liquid, and by properly selecting the thickness of the selenium.—*Phys. Zeit.,* March 1.

Magneto-Optics.—W. Voith.—Some theoretical notes on recent magneto-optical observations. The author first discusses transverse magnetic double refraction and then deals with the dissymmetry of the normal Zeeman triplet.—*Phys. Zeit.,* March.

Units, Measurements and Instruments.

Resistance Comparator.—W. C. Fisher.—The first part of an article in which the author, after discussing the advantages of the potentiometer method for comparing resistances, describes his design of "resistance comparator." The essential feature of the instrument, as shown in Fig. 3, is the employment of two sliders and a movable slide wire. The slide wire (*S/W*), provided with flexible end connections, is carried by, but insulated from, a tubular framework (*FW*) which is free to slide upon the fixed bars *BB,* shown. This framework, the top tubes of which are of square section (upon the top surface of which the scale is engraved), is actuated by the milled nut (*N*) which, since the sliders are friction-maintained, gives a micrometer movement to the slide wire. The sliders (*Ss*) have each a free hand-impelled action along their respective tubular frameworks (*F*), which also have individual micrometer movements in the milled nuts (*N, n*). Any backlash in the respective frameworks is taken up by strained springs, not shown in the drawings. The sliders carry contacts (*cc*Q) which, as shown in vertical section, can be made to impinge upon opposite sides of the slide wire *S/W,* which is of substantial diameter and hangs in mid-air. A special switch, not shown, but having instantaneous action, is provided for the rapid alteration of connections between the various circuits and for the employment of one galvanometer. The operation of the instrument is as follows: (*a*) Balance standard resistance (which is connected to slider marked "Standard") roughly by hand at any convenient point on the slide wire. (*b*) Flick over switch and roughly obtain by hand the approximate comparison balance with the slider marked "Comparison. (*c*) Check back to (*a*) and adjust more accurately by micrometer. (*d*) Check back to (*b*) and adjust more accurately by micrometer. Repeat these operations if necessary until with consecutive switch reversals no movement of the galvanometer takes place, and hence the two balancing points are definitely obtained." The novel point of a movable slide wire has for its object the fact that, whereas in the ordinary way with a fixed wire any alteration of potential in either "measuring" or "comparison" circuits entails either rheostat adjustment or a readjustment of both slides, in this instrument any alteration of potential can be rectified by adjusting or altering the position of the slide wire itself, so leaving the sliders the same relative distance apart. In this manner two separate adjustments (with readings to be taken and noted at each) are replaced by a single movement simply and quickly performed without the necessity for readings or pencil work.—Lond. *Elec.,* March 6.

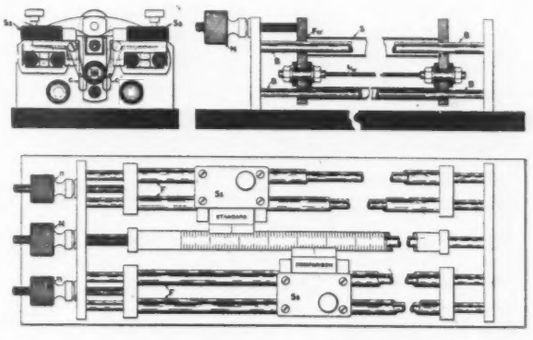


FIG. 3.—ELEVATIONS AND PLAN OF RESISTANCE COMPARATOR.

Electric Clocks.—H. H. Cunynghame.—In the last of a series of Cantor lectures on the theory and practice of clock-making the author discussed electric clocks, which he regards as the clocks of the future. The main advantages of electrical clocks are that the wheel train is done away with altogether, and they are much cheaper and simpler. The great obstacle is to get a constant battery, one that will continue in good working order for four or five years. He advocates the use of large-sized Daniell cells of the gravity type. Electric clocks may be divided into several groups. The earliest form was to have an electromagnet which attracts a mass of iron placed at the end of the pendulum rod. The drawback to this system is that in making and breaking contact, the spark which occurs tends to oxidize the metal and creates an imperfect contact.

One of the first attempts to obviate the difficulty of a constant battery was made by Hipps. This system, known as the Hipps butterfly escapement, consists of a pendulum having an armature at its end moving over contact springs; to the pendulum is attached a flipper which, when the swing of the pendulum becomes too slow, causes the pendulum to make contact with the springs and thus to receive an electrical impulse, which sets the pendulum moving again. This system does away with the difficulty of the want of constancy in the battery to a great extent, because the number of impulses are largely reduced. One clock of this type is still working satisfactorily at a Swiss observatory. In this case very great care has been taken to make the electromagnet of the finest iron. The author referred to a new clock of Fery, which works with a polarized bob, and the inventor believes he has obtained a really constant battery. Another class of clock is that known as train remontoir, or self-winding clocks, the general principle of which is that a falling weight operates a tumbler switch, which closes an electric circuit, and puts into motion a motor which winds the clock up, the circuit being broken when the weight makes another contact at the end of the wind. There are many systems of this nature, including those of Allen, Webber and Hope Jones. Next there is the "Magneta" system, which is based upon the principle adopted by Wheatstone in his early telegraphic experiments, in which he dispenses with the use of a battery and contacts. Against this advantage is the disadvantage that the clocks have to be wound up every day, although, of course, this can be accomplished electrically if necessary. A new system is the Cunynghame-Hope Jones electro-gravity detached escapment, in which a flipper on the pendulum catching in a small arm frees it and allows it to drop upon a finely jeweled roller fixed to the pendulum, and this gives the latter an impulse forward. The arm is only weighted with 1½ grams, but the armature flies forward on to the arm in such a violent way that an excellent contact is secured. Mr. Cunynghame stated that he has had this arrangement under test, and has never known the electrical part to fail. As to electric synchronization, he regards as the most simple arrangement that adopted by the Standard Time Company, in which an electromagnetic plunger drops into a cam on the minute hand and thus corrects it if either slow or fast. Cornu's method is very similar. Another plan, invented by Rudd, involves the use of two pendulums, one for time measuring and the other for the working pendulum. If the working pendulum is working inaccurately, it is corrected each hour by the time pendulum.—Lond. *Elec. Eng'ing*, Feb. 27.

Wehnelt Interrupter.—E. Renz.—An illustrated description of a device for dampening the noise of the Wehnelt interrupter during operation.—*Elek. Zeit.*, Feb. 27.

Miscellaneous.

Electric Monopoly in Germany.—E. H. Geist.—A report made to the Central Association of German Manufacturers on the proposition that the German government should take over the generation and distribution and sale of electrical energy. It is considered to be the domain of the government to carry out anything that serves the general public and from this point of view one should decide theoretically in favor of a government monopoly of electricity. But this could not be done right away without serious trouble, since numerous people would be damaged and the government could not pay fully for the damage it would do. On the other hand, the government would have to take over installations which would not be profitable. The author thinks, however, that it is proper to consider the government monopoly of electricity as an ideal goal to strive for. For the present it should be well to pass laws which would give the government the right of utilizing or buying water powers and coal mines, also electricity stations already existing or in course of erection, and the right to exert its influence on the erection of new electric stations; also the right to buy up electric street railways and to operate them (though it might be advisable that the state would only furnish the current for traction and that the street railway operation would be left to the municipalities). It is believed that when power plants and railways are taken over by the state gradually in course of time, it will be possible for the government to very greatly reduce the cost of energy production so that more and more people who now have their own isolated plants would find it profitable to buy their energy from the government. In this way a natural foundation would be laid for the government monopoly, which then could be created by law without doing damage to anybody.—*Elek. Zeit.*, March 5.

BOOK REVIEWS.

Colorado Springs Lighting Controversy. A Compilation of the Records of the Colorado Springs Lighting Controversy, with an Introduction and Epitome. By Henry Floy. New York: Illuminating Engineering Publishing Company. 327 pages. Price, $4.

One of the most interesting cases of litigation that has arisen in central-station history was that incident to a controversy between the city of Colorado Springs and the Pike's Peak Hydro-Electric Company. The principal issues presented were the meaning of the phrase, "An arc-light of standard 2000 candle-power," and the monetary damage accruing from the substitution of a 6.6-ampere series alternating-current arc lamp for "an arc lamp of standard 2000 candle-power." To determine this and other points involved, arbitration proceedings were finally resorted to, and the present volume gives a record of these proceedings, together with other matter relating to the case. The arbitration committee consisted of Prof. S. G. Carpenter, Mr. E. L. Elliott and Mr. Henry Floy, the author of the present volume. During the proceedings more than a dozen authorities and experts on electric lighting and illumination were examined on the stand, among whom were Dr. Bell, the late Prof. C. P. Matthews, Prof. J. C. Shedd, and Messrs. L. B. Marks, Alton D. Adams, R. F. Schuchardt and W. D'A. Ryan.

In an introductory section, the author gives a historical résumé of the case, together with comments on its main features and conclusions, in which latter excellent advice is given to central stations concerning the form of agreements with municipalities for public lighting. The report of the testimony comprises the greater part of the contents of the book, and in view of the standing of those who were examined and the nature of the subjects considered, this portion forms a contribution of high value to the literature of arc lighting from both the technical and commercial sides. A most interesting part of the testimony relates to the comparative efficiency of enclosed- and open-arc lights, concerning which exact figures from numerous tests were submitted. It was shown, for example, that the candle-power of the maximum ray of the full open arc lamp is not 2000, as is generally believed, but in the neighborhood of 1300; that the consumption of this lamp is about 1 watt per candle, while the consumption of the alternating-current enclosed arc may reach 3 watts per candle.

The book will be of particular value to central stations having municipal contracts for street lighting, as at some future time they may have to confront one or more of the issues of the Colorado Springs case; and all central-station and electric-lighting engineers will find a mine of useful information in the record of the testimony given by the long roll of authorities and experts.

Stationary Steam Engines. By William H. Fowler. Manchester, England: The Scientific Publishing Company. 299 pages; 326 illustrations. Price, 12/6 net.

The title of the book should be "The Design of Stationary Steam Engines," because the treatment is confined almost exclusively to a description of design details, with just enough matter relating to operation to guide the designer in his task of producing a successful engine. The properties of steam and the characteristics of boilers are not dealt with, although some information is given concerning condensers. The matter is a reproduction of articles which have appeared at various times in the columns of the *Mechanical Engineer*. A valuable feature

of the book is the numerous working drawings which relate to correctly designed machines. These drawings have evidently been selected with great care, and they cause the book to be well suited for designers and builders.

Suction Gas. By Oswald H. Haenssgen. Cincinnati: The Gas Engine Publishing Company. 88 pages, 4 illustrations. Price, $1.

In view of the increasing importance of gas engines in generating station work, information concerning the production of gas becomes more and more desirable. The present book covers the design, cost of running, development and possible utility of suction gas producers and engines. Descriptions are given of the gas generator, the vaporizer, the cooler, the condenser, the purifier, the regulator and the suction gas engine. Hints are given concerning the operation of the entire plant, and estimates are made of the cost of producing energy. The estimates are based largely on European conditions and probably are not applicable in this country, but this fact does not lessen the value of the technical information contained in the book.

Continuous-Current Engineering. By Alfred Hay. New York: D. Van Nostrand Company. 327 pages, 183 illustrations. Price, $2.50 net.

In this book Dr. Hay has exercised to excellent advantage his ability to describe electromagnetic phenomena in simple terms without sacrifice of accuracy. He has omitted many of the details, a recital of which would have led merely to confusion on the part of the reader, and has laid special emphasis on the features of real importance. In addition to direct-current generators and motors, both the design and operation of which are well covered, the book deals with storage batteries, lamps and photometry. The numerous hints as to constructive details and design constants render the book a convenient manual for reference. The work has been prepared for use as an introductory text on continuous current engineering; it is exceptionally well arranged for this purpose.

Introduction to the Study of Electrical Engineering. By H. H. Morris. New York: John Wiley & Sons. 404 pages; 179 illustrations. Price, $2.50 net.

The author states that the plan of this work is to take the every-day experience of the student as the basis of a general survey of electrical application. The treatment covers fundamental electrical and magnetic quantities, materials of electrical engineering and magnetic circuits, construction and operation of generating station, transformers and motors, and their applications, electric lighting and heating, electrical measurements, and the transmission of intelligence. The method of treatment, which is very unusual, will find many advocates and probably equally as many opponents. The author has used excellent judgment in the selection of material, and extreme care has evidently been exercised to render the treatment accurate in thought and in the expression thereof. In fact, from the standpoint of simplicity in language and correctness in terminology, the book is one of the most satisfactory that has come to the reviewer's notice. The book is lacking in depth (according to the stated desire of the author), but the accuracy of presentation more than compensates for this deficiency. The conscientious use of the book will give to the student a solid foundation for further analytical work.

Practical Physics. By W. S. Franklin, C. M. Crawford and Barry MacNutt. New York: The Macmillan Company. Vol. I, 173 pages, 75 illustrations; price, $1.25 net. Vol. II, 160 pages, 71 illustrations; price, $1.25 net. Vol. III, 80 pages, 49 illustrations; price, 90 cents net.

For the convenience of the students this manual is issued in three small volumes. The first deals with precise measurements and experiments in mechanics and heat; Vol. II treats of elementary and advanced measurements in electricity and magnetism, while Vol. III is devoted to photometry and to experiments in light and sound. In Vol. I excellent suggestions are made as to the procedure in the laboratory and the treatment of data. The method of assigning an experiment to each student at the completion of a laboratory period so that he may prepare in advance for the experimental work is of great importance with reference to the economy of time spent in the laboratory. Carried to its limit, this method might render the student merely a collector of instrument readings for record on his data sheet. A student may sometimes learn more from the mistakes he makes and is forced to correct. When supervised by competent instructors, who carefully examine the reports of the experiments, the method should prove highly advantageous.

The main subject matter of the manual deals with 133 well chosen experiments in physics. With a few exceptions, the experiments do not require expensive equipments, so that the manual can be used in almost any physical laboratory. Moreover, although the statements and the explanations are unusually accurate, they are worded in simple concise terms, the meaning of which can be appreciated by any student. The manual could be rendered more complete and instructive by including more tests on magnetism, magnetomotive force, electromagnetic torque, concerning which the treatment in the usual laboratory text is either confusing or misleading, and Vol. II of the present manual is almost silent. The arrangement of the manual is excellent, and it should prove acceptable to instructors and students in all schools maintaing physical laboratories.

High-Voltage Oil Circuit-Breakers.

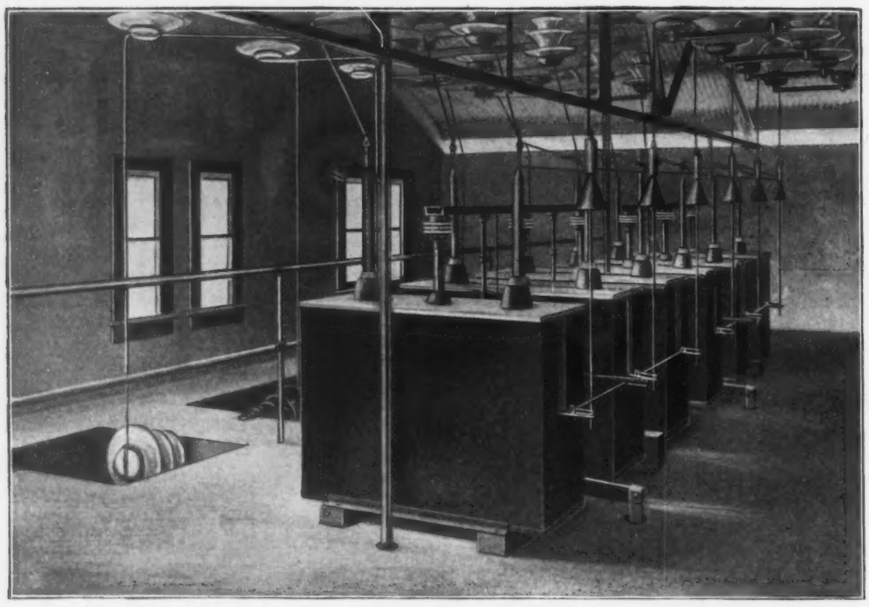
An interesting installation of what is said to be the first 75,000-volt automatic, oil circuit-breakers that have been placed in regular service on any transmission system is shown herewith. The circuit-breakers operate without the use of series transformers and the illustrations show the breakers as installed in the Edison Electric Company's substation at Fernando, Cal. In the construction of the mechanism of this switch, the movable contacts, which are of the knife-blade type, constitute part of a simple pantograph, the lower part of which is pivoted to the metal cap of the central insulator and the upper part to the end of a wooden rod, which is attached to a special porcelain insulator secured to the channel iron cross-bar. A vertical movement of the cross-bar imparts a horizontal movement to the ends of the blades as they leave the fixed contacts, these ends being brought together in the center of the tank in the open position of the switch. The cross-bar is carried on two guide rods placed in cast-iron frames between the tanks, as shown in the illustration, the vertical movement being given to it by means of a rocker shaft beneath the central tank, on which are two arms which are connected to the lower ends of the guide rods by means of links. The counterweight is also mounted on the rocker shaft. Coil springs for opening the breaker when tripped are placed in each cast-iron frame between the tanks, where they operate directly on the guide rods. The tanks are of iron, and the covers of marble, made in two pieces, either one or both of these pieces being removable, without disturbing anything else, for the purposes of inspection.

The circuit-breakers shown in the illustration are arranged for hand closing, the handle being carried loosely on the rocker shaft and connected to the closing mechanism by means of a short lever and a dog, the dog being released by the action of the tripping mechanism in the event of an overload or short-circuit. The tripping mechanism, which is very simple in design, is set in motion by any one or any two of the trip coils independently, or by all three acting together, and is automatically reset each time the circuit-breaker opens.

The trip coils, consisting of only a few turns of wire of small diameter, are placed directly in the line, being suspended from the insulators of the disconnecting switches and supported by the connection to the switch terminals. The movable core has a very long creepage surface, approximately 60 in., and a

dielectric strength of at least three times the line voltage, thus giving the insulation of the coils a very much higher factor of safety than that of the best series transformers.

These circuit-breakers have been installed in the substations on the Edison Electric Company's 75,000-volt transmission line from Kern River to Los Angeles, and have operated automatically numerous times with success. They are manufactured by J. N. Kelman, 1000 North Main Street, Los Angeles, Cal.



HIGH-VOLTAGE OIL CIRCUIT-BREAKERS.

Fly-Wheel Motor-Generator Sets for Operating Electric Hoists in the Kendall Mines.

An electric-hoist equipment recently installed by the Kendall Gold Mining Company in a mine of the North Moccasin Mountains, Mont., is designed to prevent intermittent load on the hoist from causing fluctuations in the electrical distribution system. The Kendall group of mines is operated by electric power supplied by a hydraulic power-house equipped with one pair of 23-in. turbines direct-connected to a General Electric revolving-field alternator of 400-kw capacity, 6600-volt, 60 cycle, three-phase. The power house is situated about two miles from a never-failing warm spring having a delivery of 8500 cu. ft. of water at 170 deg. F. all the year around.

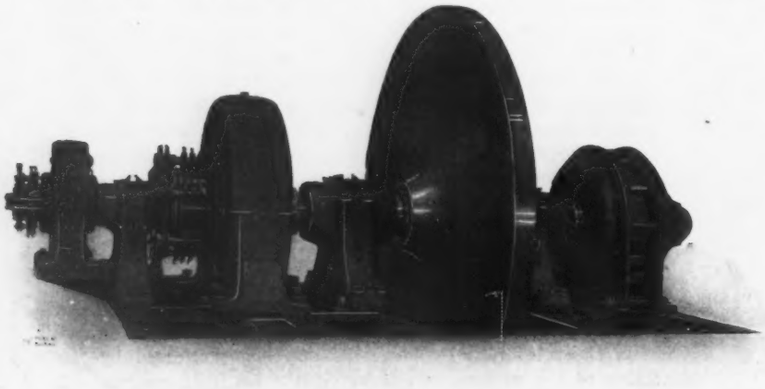


FIG. 1.—FLY-WHEEL MOTOR-GENERATOR SET FOR MINE HOIST.

The transmission line has a total length of seven miles and operates at the generated voltage of 6600 volts. There is a 100-hp General Electric induction motor which drives a Gates crusher, three sets of 15-in. x 26-in. Gates high-grade rolls, one Jeffery jig screen and two large belt elevators. This outfit has a reduction capacity of 500 tons per 24 hours. Besides these, there are installed one 30-hp, one 15-hp, three 10-hp and four smaller General Electric induction motors driving conveyors, centrifugal pumps, exhaust fans, elevators, drill presses, etc. A 75-hp induction motor is used for driving a seven-drill air compressor.

For hoisting the ore from the different levels there is a double drum made by the Denver Engineering Works. The hoisting equipment is designed to raise 2000 lb. of ore from a 1000-ft. level every 103 seconds when operating two drums, and every 170 seconds when a single drum only is in operation.

The mine shaft has two compartments, and extends vertically to a depth of 1000 ft. Two cylindrical drums are used, which are provided with the usual clutches for individual and combined running, each drum operating a compartment in which the weight of the rope is always balanced by an individual tail rope, whether the other compartment is working or not. This rope is 1 in. in diameter and weighs 1.6 lb. per foot. The hoisting speed is 1000 ft. per minute. Each compartment is supplied with one skip weighing 1400 lb., and having a capacity of 2000 lb. or ore.

Theoretical curves of horse-power input to the hoist, when running one compartment (unbalanced operation) and two compartments (balanced operation), both show an unusual demand for power which occurs during the period of acceleration.

The capacity of the generating station being somewhat limited, the large rush of current incident to starting and accelerating the hoist tends to produce undesirable voltage fluctuation in the system, and the equipment here described was designed to eliminate this trouble and improve the regulation of the line.

To this end an outfit was supplied which permits of the most perfect speed control, allowing the load to be accelerated as rapidly or as gradually as desired. The equipment was also supplied with a means of equalizing the demand upon the power system, so that instead of being intermittent in character it is practically constant.

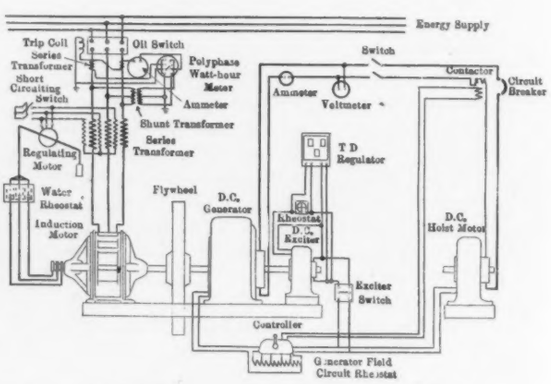


FIG. 2.—DIAGRAM OF CONNECTIONS OF FLY-WHEEL MOTOR-GENERATOR SET.

electrically-braking the load in a manner which not only gives complete control over the retardation of the moving parts of the hoist, but also returns a considerable portion of their kinetic energy to the fly-wheel.

The hoist equipment comprises a shunt-wound direct-current motor, arranged to be geared to the hoisting drums, the motor receiving its power from a motor-generator set driven from the main power system. This set consists of an induction motor and a direct-current generator with a fly-wheel swung between them, and a direct-current exciter overhung at one end. The function of this latter machine is to excite the field of the generator and that of the direct-current hoist motor. The direction and speed of rotation of the latter machine is controlled by reversing and varying the strength of the field of the direct-current generator by means of a rheostatic controller, which is conveniently located for the hoist operator.

In this set the induction motor is a three-phase, 60-cycle, variable-speed machine of the collector-ring type, while the direct-current generator is provided with commutating poles and is so designed that it will commutate heavy currents with weak fields.

The fly-wheel is a steel casting, machined all over and perfectly balanced; it weighs about 12,000 lb. and operates at a peripheral speed of about 18,000 ft. per minute. The wheel is used to store energy when the hoist is not in operation, and gives up this energy when the demand on the line is at a maximum.

To obtain this effect on the part of the fly-wheel of alternately storing and surrendering energy the induction motor is arranged for variable-speed operation, changes in speed being automatically controlled by the variation of the main line current, which is led through a small three-phase regulating motor operating a water rheostat in series with the secondary winding of the motor.

The torque which is produced by the full-load value of the main line current in the windings of the regulating motor is exactly balanced by the weight of the moving parts of the water rheostat, so that there is no change in the resistance that is in series with the rotor winding of the motor-generator set so long as the motor is taking full-load current. If, however, it should demand more or less, there is an immediate change in the resistance of the water rheostat, tending to accelerate or retard the speed of the motor-generator set to such a point that the induction motor once more takes full-load current. The voltage of the exciter is maintained at a constant value during the speed variation of the motor-generator set by means of a Tirrill regulator.

The company's plant has sufficient capacity to furnish the Barnes King Development Company with power for operating an outfit of motors similar to that used at the Kendall Mines, and also power for lighting the town of Kendall. All of the electrical apparatus installed has been furnished by the General Electric Company, Schenectady, N. Y.

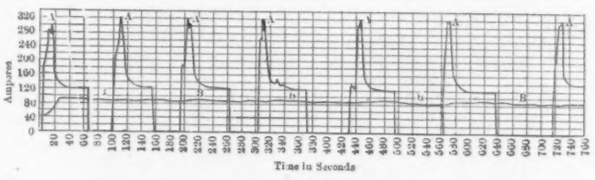


FIG. 4.—CURRENT INPUT TO MOTOR AND CURRENT OUTPUT FROM GENERATOR OF FLY-WHEEL SET.

The operating force is composed of H. H. Lang, superintendent of Kendall Gold Mining Company and general manager of North Moccasin Gold Mining Company; C. A. McLain, mine foreman; E. F. McLean, mill foreman; L. O. Wilson, electrical engineer; A. B. Fox and E. S. Kinney, bookkeepers, and Joseph Coyne and Bryan Bradley, assayers.

Hollow Reinforced-Concrete Pole.

The accompanying illustrations show the details of a hollow reinforced concrete pole designed by Mr. F. H. Tidnam, manager of the Oklahoma Gas & Electric Company, of Oklahoma City, Okla. The inventor claims that the cost of these poles is the same as for wooden poles of similar size. The framework or cage for the pole comprises longitudinally-extended wires or rods clamped in place as indicated. A core is inserted within the cage before the concrete is poured, and after the latter has set, the core is withdrawn, thus making a pole light in weight without sacrificing strength. Fig. 2 shows one of these poles close to a wooden pole of the same size. The advantages of concrete poles over wooden poles, aside from strength, are improved appearance and durability.

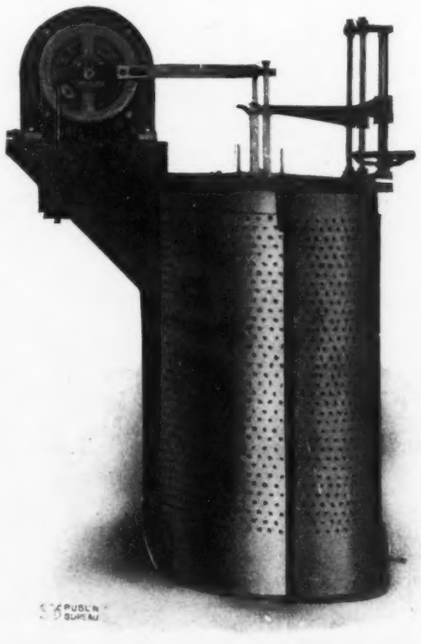


FIG. 3.—AUTOMATIC SLIP REGULATOR.

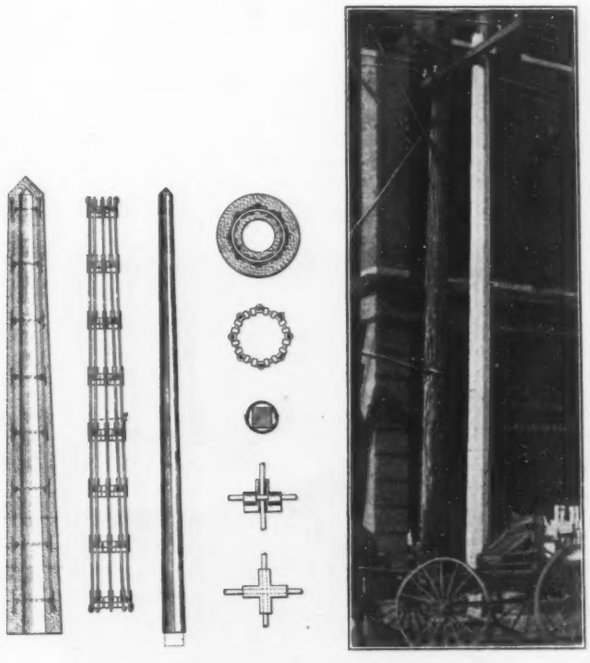


FIG. 1.—DETAILS AND COMPLETE POLE.

Vacuum Electric Massage Vibrator and Shampoo Comb.

The accompanying illustrations show a vacuum massage vibrator and shampoo comb made by Harvey & Hill, Flatiron Building, New York. The outfit consists of a small direct-

FIG. 1.—VACUUM MASSAGE VIBRATOR.

current electric motor which is direct-connected to a blower and exhauster. The former gives a current of air under pressure and the latter is capable of maintaining a vacuum of about 5 in. The vacuum side is connected to a vibrator, which may be provided with three different sized cups, each of which is suited for particular parts of the body. At the top of the vibrator is a valve for regulating the amount of suction. The motor is provided with a pair of slip rings connected to certain commutator bars so that an alternating current at frequency of about 15 cycles is fed to the solenoid for imparting the necessary motion to the vibrator. A three-step resistance in the top of the vibrator permits of as many distinct pressures or degrees of strength to the vibrating motion. The feature of this type of massage machine is that instead of the usual ham-

FIG. 2.—SHAMPOO COMB.

mer blow, the flesh is sucked up into the cup so that the peculiar muscle working and pulling effect of hand massage is obtained. The shampooing comb is of hollow metal, and air under pressure passes through it and out of holes in the ends and sides of the teeth. By this means the scalp may be cleaned, the hair dried, or lotions applied to the roots of the hair. The back of the comb is provided with an electric heater so that the air, lotions, etc., may be heated if necessary. In addition a plug connects the comb with the alternating-current circuit from the motor so that electric scalp message is also possible. The outfits are made in three different sizes.

Acme Arc Lamp.

Queen & Co., Philadelphia, have placed upon the market the lamp shown in the accompanying illustrations, known as the "Queen Acme Arc," which is claimed to stand alone in current economy and in the quality of its light, resembling daylight, while its freedom from all flickering admits of work being done that would be impossible under the ordinary arc lamp. The decorative appearance of the lamp and its small

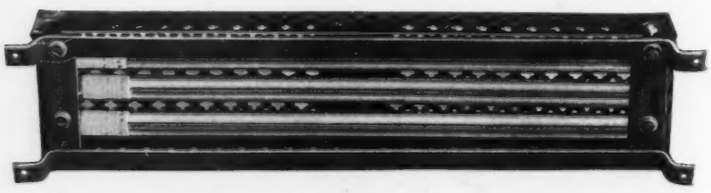
FIGS. 1 AND 2.—ACME ARC LAMP.

size, being only 15 in. over all, renders it especially suitable for hotels, shop windows, reading rooms, ball rooms and all other places where strong light is needed, yet where the ordinary heavy and cumbersome arc lamp is impossible. Its short length also allows it to be used in factories with low ceilings, hitherto found so difficult to light. Wherever true color values are to be maintained, as in color-printing plants, textile mills, dry goods stores and art galleries, the Acme arc is claimed to be particularly advantageous.

The lamp equipped with opal globe and reflector is stated to give 800 candle-power at 2.5 amperes; with clear globe and reflector the candle-power is 1500 at 2.75 amperes, and 1000 candle-power with opal globe at 2.75 amperes. The lamps are differently adjusted, taking from 1.5 to 3.5 amperes and used in 110- and 220-volt direct-current and alternating-current work also. The lamp can be used equally well for indoor and outdoor work.

Automatic Resistor for Arc-Lamp Circuits.

The accompanying illustration shows a rheostat, the resistance of which varies automatically, which has been developed



AUTOMATIC RESISTOR.

by Heinrich Beck for use in series with arc lamps. The resistor material is iron, which, as is well known, possesses a high temperature-resistivity coefficient. An iron wire, whose

resistance varies greatly with a change in temperature and therefore with a change in the current, is kept taut by means of springs to prevent sagging when it becomes hot; it is mounted in a glass tube containing hydrogen gas, so that the wire does not oxidize or disintegrate.

The resistor complete, as illustrated, consists of three units connected in series and held within an iron frame provided with suitable binding posts. As indicating the effectiveness of the device, it is stated that when the resistor was connected in series with two flaming arc lamps designed for a normal current of 8.75 amperes at 110 volts, the current increased to 9 amperes when the e.m.f was raised to 120 volts, and it decreased to 8.50 amperes when the e.m.f. was lowered, the total change in current being only 6 per cent for a change in e.m.f. of 20 per cent.

These automatically regulating resistors, known by the trade name "Reglers," are handled by Louis J. Auerbacher, 488 St. Nicholas Avenue, New York, the American representative of the manufacturer.

Electrically-Driven Coffee Grinders.

A number of types of electrically-driven coffee grinders are being placed on the market by the A. J. Deer Company, of Buffalo, N. Y.; those intended to be operated from alternating-

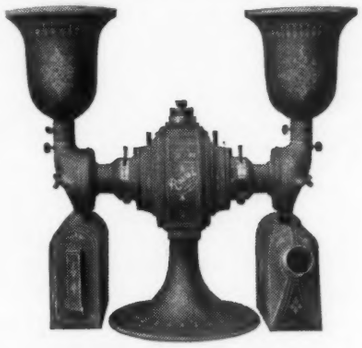


FIG. 1.—COFFEE GRINDER.

current circuits being equipped with Emerson motors of the full-load automatic-start type. One style of grinder widely used is shown in Fig. 1, and a combination coffee grinder and meat chopper is shown in Fig. 2. The coffee grinders are provided

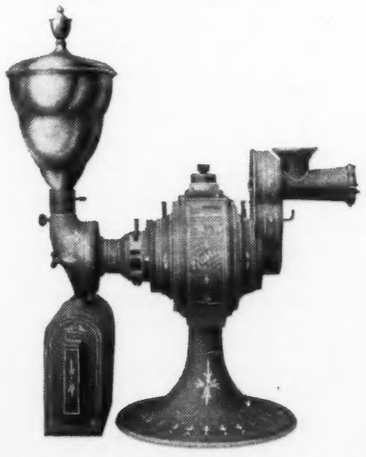


FIG. 2.—COMBINED COFFEE GRINDER AND MEAT CHOPPER.

with sharp knives which cut the bean without crushing it so that the oil cells are not broken and the caffeine does not evaporate. The coffee mills are made in twenty-two different styles and being widely advertised by the manufacturing company are among the numerous devices for household service often found connected to domestic electric-lighting circuits.

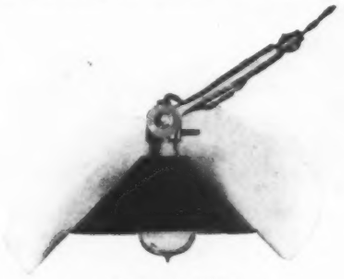
Electrical Equipment for Santos, Brazil.

The Companhia Docas de Santos (Santos Dock Company) through whose docks most of the coffee exported from Brazil passes, has recently placed a large order with the General Electric Company for the complete electrical equipment of its substation and docks at Santos. The order is comprehensive and includes six 3000-kw, water-cooled, three-phase, 60-cycle, 40,000-6600-volt transformers, a 23-panel switchboard and the necessary cables and wiring supplies. The order also includes five 50-light, constant-current transformers, 208 series arc lamps, 420 multiple arc lamps, a large number of induction motors for operating air compressors, hoists, cranes, etc., and a large number of oil-cooled transformers.

Besides furnishing power for the docks, the substation will also supply energy for light and power to various other enterprises thereabout. Power is supplied at a line potential of 40,000 volts by a hydro-electric plant some 35 miles from Santos, the equipment of which was furnished by the General Electric Company some two years ago.

Adjustable Incandescent Lamp Support.

The accompanying illustration shows a simple and rugged support used in connection with drop-cord circuits for directing the light from incandescent lamps to any desired angle. The device is easily attached to a lamp cord, and may be used in connection with any style of shade. It is especially adapted for

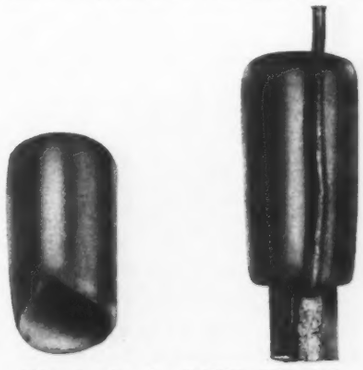


LAMP SUPPORT.

use in machine shops, factories, draughting rooms, shipping rooms, offices, bank vaults or in any other place where concentrated light is required. The Electric Specialty Company, of Cleveland, Ohio, is the manufacturer of the support, which is made of steel, properly insulated.

Ground Pipe Cap.

A number of central-station companies, of which the Commonwealth Edison Company, of Chicago, is one of the largest examples, ground the secondaries of transformers and lightning



FIGS. 1 AND 2.—GROUND PIPE CAP.

arresters by driving a long length of 5/8-in. galvanized iron pipe into the ground at the base of the pole. The matter of getting a good connection between the top of the pipe and the ground wire leading down the pole has been troublesome. There has also been trouble with battering the end of the pipe by driving

upon it so that the end had to be sawed off before the electrical connection was made to the top. The G. & W. Electrical Specialty Company, of 128 West Jackson Boulevard, Chicago, has just brought out a malleable, cast, galvanized-iron pipe cap shown in Figs. 1 and 2. The wire is doubled inside the cap and is made tight by driving on the cap. The cap also keeps the end of the pipe from being battered during driving. After the pipe is driven, the wire is bent up as shown in Fig. 2. The cap has an interval groove along one side for the wire. The form of the inside of the cap has been made a matter of considerable study in order to get a shape which will hold the wire firmly and make a good electrical contact, and at the same time will not cut the wire when driving on of the cap is first started. The cap is made for a ⅝-in. pipe, and when No. 6 wire is used the wire is doubled to make a good joint. When No. 4 wire is used doubling is not necessary. Joints so made show a voltage across the joint of .0114 with a current of 50 amperes.

Non-Replaceable Fuse Device.

In order to furnish a better protection against fires caused by overloaded electric circuits, Mr. G. E. Painter, of Baltimore, Md., has lately brought out a non-replaceable fuse device. As shown in the illustrations, the general appearance of the device is very similar to the fuse blocks now in use, the only difference being that an extra fuse is connected in series with the fuse terminals for the ordinary type of fuses, and is placed in the bottom of the device. The non-replaceable fuse is intended to have a current-carrying capacity about 10 per cent greater than

FIG. 1.—DETAILS OF FUSE PLUG RECEPTACLE.

the fuse block is designed to carry, so that it will not blow as long as the block is properly fused. In case a fuse having a higher rating than the non-replaceable fuse is inserted in the clips, or the terminals bridges with wire, etc., the non-replaceable fuse will blow on an overload, short circuit, etc., and inasmuch as the fuse cannot be renewed, a new fuse block becomes necessary. As at present constructed, cut-outs will take fuses rated as high as 30 amperes, and while at the time of inspection all the different branch circuits are tried out to see that they are not over-fused, it is an easy matter to insert larger fuses

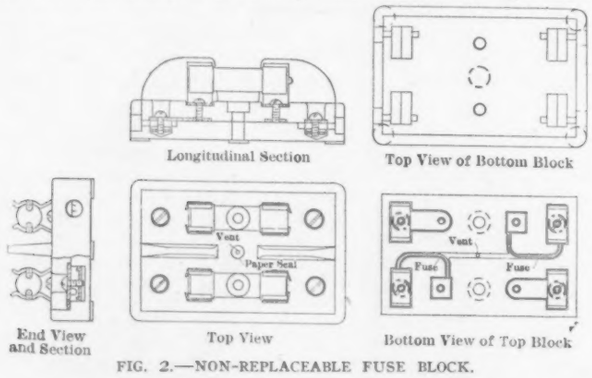
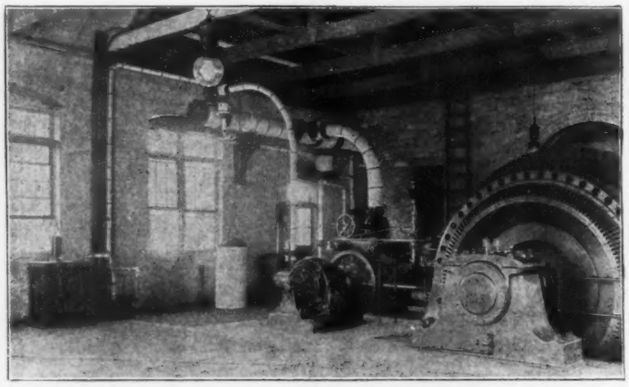


FIG. 2.—NON-REPLACEABLE FUSE BLOCK.

so as to permit the circuits to carry heavier loads. In the type of fuse device shown, overloading of the circuits after the work has been inspected is checked. Fig. 1 shows the fuse plug receptacle on the left and at the right the non-replaceable fuse in the bottom. The fuse plug shown alongside of the receptacle reveals the usual way of bridging this type of fuse. Fig. 2 illustrates a straight-line fuse block fitted with the non-replaceable fuse. The terminals for the wires are inside of the porcelain, so that it is not easy to short-circuit at this point.

Continuous Lubrication System.

It is generally recognized that oil filters and continuous lubrication systems are conducive to economy in power-station operation. For this reason filters and oiling systems are usually found in all modern stations. The accompanying illustration shows an interior view of the power house of the McKell Coal & Coke Company, of Glen Jean, W. Va. This company operates a number of collieries scattered at convenient points over a tract of several thousand acres. Electricity for operating these numerous mines is supplied from a central power plant, high-tension alternating current being transmitted to scattered substations where it is transformed and converted into low-tension direct current. The illustration shows the first 500-kw unit in the power house, and at the left



POWER PLANT OF A WEST VIRGINIA MINE.

may be seen a duplex-type oil filter and the circulating pump of a continuous oiling system used for lubricating all the bearings. Overhead, among the roof trusses, a reservoir is placed from which pipes lead to feeds fitted to all the bearings. All oily drips are drained to a tank beneath the engine-room floor from which they are automatically lifted to the filter. After being thoroughly cleaned the oil is pumped back to the overhead reservoir to be used over again. The "White Star" filter and continuous oiling system made by the Pittsburg Gage & Supply Company, of Pittsburg, Pa., are in use.

Convenient Soldering Fluxes.

For convenience, prepared soldering fluxes are put up in a number of forms—sticks, paste and liquid. The first form is used for general ready soldering where the parts are more or less accessible; the second form satisfies the demand of "out-of-reach" jobs where the stick would be unhandy, and the last form suffices where the flux is to be applied with a brush or squirt can, or the parts soldered are to be dipped in a bath of the flux. The L. B. Allen Company, of Chicago, Ill., manufactures all the forms mentioned, and they are claimed to be non-corrosive. The soldering sticks are 5 in. long and ⅞ in. in diameter. The preparation is rubbed on the heated joint; the solder being applied in the usual fashion. The soldering paste is applied to the joint to be soldered with a rag, splinter or finger and without any preliminary scraping. This form is used chiefly on big joints for electric-light wiring, switchboards, heavy cable work, etc., where this form of flux saves much time. The non-acid fluid flux consists of a solution of soldering salts into which the article soldered is dipped, or which may be applied with a brush or squirt can. This form of soldering flux is used considerably in general commutator and armature work. As is well known in electrical work, the problem is to secure an electrical as well as a mechanical joint. To satisfy this requirement the flux must not destroy or corrode the metal. Tests made with the Allen preparations are claimed to have shown excellent electrical properties and to have given a strong mechanical joint as well.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade in the primary branches was quiet, and operations in industrial lines during the last week was below normal. The opening of spring saw an expansion in retail trade, but fall trade was backward. The weather conditions were favorable to farming activity, and the reports from the winter wheat crop continue excellent. The earnings of the railways continue to grow less, and bank clearings show heavy decreases, not only from last year, but a decrease also from last week of 7 per cent. The stock market continues to advance, collections show a little improvement, but are still far behind, though money is easier. As compared with last year, the lumber manufacturing trade is very quiet, and current production is far below 1907. The iron and steel markets are slightly more dull than two weeks ago, but the general tone is optimistic, although everything depends upon the willingness, or rather the ability, of railroads to purchase supplies, which they do not seem inclined or able to do at present. In ordinary times the railroads consume about 60 per cent of the iron and steel output, but during the last 10 days there has been a halt in the improvement which has been taking place since the beginning of the year. The demand for structural material is light, but a number of large orders have been given out, and there is prospect of a rather heavy tonnage. *Bradstreet's,* for the week ending March 26, reports 286 business failures, against 303 last week, 166 in the corresponding week in 1907, 169 in 1906, 227 in 1905, and 212 in 1904. Inquiries made among the various electrical interests show a healthy and optimistic condition in that line. The General Electric Company during the last month has increased its rate of business from the rate of about $30,000,000 a year to $50,000,000, and the Western Electric Company is experiencing a considerable increase in the demand for telephone apparatus owing to the fact that its customers, the telephone companies, have stocks unusually depleted, while the comparatively new policy of the company in selling to independents is stated to be beginning to assume considerable proportions. The Westinghouse Electric Company is booking orders at the rate of $1,500,000 a month, most of which are small orders. Each month since December the company has shown improvement over the preceding month, and it is expected that the March total of orders will reach $1,800,000. The company has increased the working force about 20 per cent, and the receivers have effected important operating economies which will save between $750,000 and $1,000,000 yearly. The efforts to rehabilitate the various new Westinghouse companies are reaching a satisfactory conclusion. The copper wire business, while much behind the same period of last year, shows considerable improvement, and coincident with the advance in brass prices the manufacturers of copper wire have raised their list of quotations to a basis of 13½c. copper, this advance, as in the case of brass, being the first made by the manufacturing interests in many months. A single sale of 3,000,000 ft. of copper wire was made in Boston last week by one of the large companies dealing in that line of goods. The export demand continues heavy, in many instances being a considerable percentage over the export trade for the same week in 1907.

THE MACGOVERN-ARCHER COMPANY, New York, has been formed to transact the same kind of business, namely, the buying and selling of electrical and steam machinery, as was carried on by the old Rossiter-MacGovern & Company for the past 12 years. Mr. MacGovern entered the electrical field when barely 23 years of age and at once organized the firm of Rossiter-MacGovern & Company. At that time, the buying and selling of electrical machinery of modern design that had seen some service, but by reason of rapidly changing conditions was somewhat out of date, was in its infancy. Mr. MacGovern was quick to see the possibilities offered by reason of the number of consolidations that were being effected in both the street railway and lighting field which was displacing a large amount of first-class apparatus. The result was that he rapidly built up the business to large proportions. Two years ago Rossiter-MacGovern & Company was reorganized and new interests were taken in with a view of extending operations into the contracting and construction field. This branch of the business unfortunately was not successful and it was deemed best for all the parties interested to apply for a receivership for the old company. Mr. Archer, who is associated with Mr. MacGovern, is well known in the street railway and lighting circles, having been with the old concern as sales manager for about six years. The new firm will adhere strictly to the handling of high-grade electrical and steam machinery.

ELECTRICAL PLANT FOR PINOS ALTOS MINES.—The Pinos Altos Mines Company, whose property is situated on the Chihuahua & Pacific Railroad in Mexico, and which has its own water-power, will install two 500-hp water-wheel-type generators in their generating stations, together with exciter, switchboard, lightning and line protection apparatus. The energy from this generating station will be transmitted about six miles at 6600 volts to a substation which will be equipped throughout with lightning protection and line apparatus, also step-down transformers and switchboard. In this receiving substation there will be also installed a motor-generator which will be used to convert the alternating to direct current for use in connection with a 3-ton mining locomotive, used to carry ore between mine and mill. A direct-current switchboard will be provided to control the railway generator and feeder circuits. Two 50-hp motors will be installed at the mill to drive the stamps, crushers, pumps, etc., together with two 20-hp motors, one 40-hp motor and one 30-hp motor and the usual circuit-breakers, switches, etc. In addition to the power equipment there will be a complete lighting installation. The Pinos Altos Mines Company is a Pittsburg corporation, and the sale of the apparatus described was effected by G. & O. Braniff & Company, agents in the Republic of Mexico for the Westinghouse Electric & Manufacturing Company.

GENERAL ELECTRIC ORDERS.—Among the orders recently received by the General Electric Company are the following: 300 four-motor equipments for the Chicago Railways Company; three 1000-kw, 2300-volt, 3-phase alternators for the Manchurian Railway, Corea; 25 600-volt motor equipments, and 40 oil-cooled transformers for the Sao Paulo Light & Power Co., Sao Paulo, Brazil. A shipment of two 50-kw cross-compound marine sets together with switchboards and necessary instruments has been made to Olongapo, P. I. These will be used in the U. S. Government dry-dock Dewey, which recently made the trip around Cape Horn. Another recent order is the electrical equipment for a dock and a sub-station of the Santos, Brazil, Dock Company, which includes six 300-kw transformers, a 23-panel switchboard, five 50-light, constant-current transformers, 628 arc lamps and a large number of induction motors.

CHICAGO MOTOR CONTRACTS.—Roth Bros. & Company, of Chicago, were the successful bidders on the large motor contract for the Federal Company, manufacturers of plumbers' supplies. There were a number of competitors in the field. The contract includes a total of about 40 motors, ranging from 1 horse-power up to 15 horse-power, some of which will be direct connected to machine tools and others will be employed for shaft driving. Roth Bros. & Company were also successful in securing the contract for eight motors and a generator for the Mercantile Steam Laundry's new plant, Chicago.

CHANGE IN GERMAN TELEPHONE RATES.—The German government, which owns and operates the telegraph and telephone systems of the Empire, except in Bavaria and Wurtemburg, proposes to change the present mode of telephone charges, according to a report of Consul-General Richard Guenther, of Frankfort. A certain fee for every call or conversation will be charged instead of a fixed sum per year.

SUSQUEHANNA POWER.—We are informed that the Susquehanna County Electric Power Company, Susquehanna, Pa., has a number of good sites for the location of industries with cheap electrical power available. The land would be given free to desirable parties. J. R. Harris is superintendent.

THE COPPER MARKET.—The boom in copper, heralded for some time, made substantial progress last week, if reported sales count for anything; but Monday's closing prices of 13¼ to 13⅜ were only about ⅛ of a point higher than a week ago. It is reported that a sale of 100,000 pounds of copper was made last week at 13¾c. a pound, and many fairly good-sized purchases at 13¼ were said to have been made, while the General Electric Company was credited with purchases to the extent of 6,000,000 pounds. Inquiries among the leading electrical interests in this city and elsewhere show that there has been no radical change in the general situation, nor have any of the larger concerns gone into the copper market for any great amounts. But the unmistakable improvement in business, and in the prospects of the electrical companies, is of considerable importance to the copper interests. In the last three years the three large electrical companies have consumed about 150,000,000 pounds of copper yearly, and adding the copper consumption of the lesser companies would bring the total to about 200,000,000 pounds per annum. All the three principal companies report more and larger orders, and an increased volume of inquiry which will result in business sooner or later. Many of the customers of the large companies have not been in the market for a long time, and it is practically certain that the next few months will see them again in the field. Reports from Boston state that all the large producing and selling interests are sold out up to date, and have no more spot copper on hand. Phelps Dodge were sold out some time ago, and the Lewisohns closed out their last half-million for New York export at 13¼. It is stated that the United Metals Selling Company cleaned up every pound of spot copper it had on hand, several days ago. During the week the foreign shipment continued much better than was expected. In the week ended March 21, there were exported from the port of New York 8,322,995 pounds of copper, all of which, except a trifle more than 1,000,000 pounds, was consigned to European ports. The week's shipments brought the amount of exports for the year up to about 155,000,000 pounds, and in the 26 weeks ended March 21, the total amount of copper shipped from the port of New York was nearly 365,000,000 pounds, an almost unparalleled amount On Monday there came a halt in the advancing movement of copper, and the fact was more evident that a copper "boom" requires to be backed by substantial buying orders. Quotations on the Metal Exchange closed on Monday as follows:

Lake	13 @13¼
Electrolytic	13 @13⅛
Castings	12¾ @12⅞

The London market was as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	60 5 0	61 0 0
Standard copper, futures	60 12 6	61 7 6
Market	Easy.	Strong.
Sales of spot		300 tons
Sales of futures		1,400 tons

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 10 0
London, futures	64 10 0	56 17 6
London, best selected	67 10 0	61 0 0

Reports from Michigan state that it is probable that the Lake Superior output of copper for 1908 will be about the same as in 1906, or about 230,000,000 pounds of fine copper, as compared with 210,000,000 pounds for 1907. Calumet & Hecla, which made 100,000,000 pounds of fine copper in 1906, and only 84,000,000 pounds last year, could increase production by about 1,500,000 pounds monthly without any great effort, and the Osceola mine could do better this year than last. The Baltic is the only other mine in that district in shape to increase production during this year. The production of the Baltic during the last half of the year should be about 2,000,000 pounds a month.

ELECTRICITY IN STEEL MILLS.—The new steel mills at Gary, Ind., furnish an indication of the great possibilities existing for the extension of the use of the electric motor. The Indiana Steel Company at that place is installing an electrical generating equipment which will supply current for motors which will run practically all of the machinery of the great plant. Gas engines supplied by waste gases will be directly connected to 2000-kw generators of both the direct-current and the alternating-current types. One of the most interesting features of the equipment is the remote-control, bench-type switchboard, which resembles somewhat the board now used in the generating station of the Electrical Development Company of Ontario, at Niagara, but differs therefrom in many mechanical details. All control switches are effectively interlocked, both electrically and mechanically. The main circuit switches are electrically operated either by motors or by plunger magnets. The direct-current generators will deliver energy to a storage battery, which will then distribute to variable-speed motors throughout the plant. A split-pole rotary converter will allow the alternating-current generators to assist the direct-current machines when necessary, or will cause the battery and direct-current machines to supply energy to the alternating-current system when desired. A commutating-pole booster controlled by means of a carbon regulator serves as a flexible link between the direct-current generators and the storage batteries. All of the apparatus throughout the mill will be motor driven, the largest motor being a 6000-hp machine for running the rail mill. On account of the desire to erect the mill with the least possible delay, the contracts for the apparatus were placed with a large number of companies, who have worked with the greatest possible speed in building the machinery. All of the large electrical manufacturing companies were awarded contracts.

Financial Intelligence.

THE WEEK IN WALL STREET.—Although, as a whole, the stock market during the week showed a gain, the trading was more professional than it has been at any time since the present bulge in prices began, and the speculative element stood out more conspicuously than heretofore. There were many indications that manipulative interests were at work, and the operation of cliques was particularly apparent. Since March 4 there have been only five days when prices on the Exchange have not advanced, and the gain during this period in the standard securities has averaged about 7 points. The decision of the Supreme Court against the legality of the Minnesota and North Carolina rate legislation, the President's message, which cheered by its mildness, and the reopening of the Knickerbocker Trust Company, were all features which gave confidence to operators. There was the usual quota of bear news, but Wall Street, according to its latest tenets, chose to heed only optimistic sounds. As the week progressed, however, the market lost its extremely strong tone and showed a tendency to hesitate, rallying Tuesday and Wednesday on covering by shorts. Among the specialties to which the professionals devoted their attention during the week were such neglected industrials as lead and sugar. Consolidated Gas also showed strength, and among low-priced stocks, Erie and Southern Railway showed a tendency to regain ground. Amalgamated Copper was strong on the improved copper situation. On Tuesday Westinghouse common was lifted from a high of 40¼ of the previous day to 59¼, and on Thursday reached

NEW YORK.

	Mar. 23.	Mar. 31.	Shares sold.		Mar. 23.	Mar. 31.	Shares sold.
All-Ch.	7	7¾	2,750	Int-Met., com..	7¼	7½	7,335
All-Ch. pfd....	20½*	18½*	2,600	Int.-Met., pfd..	18¾	20	17,026
Amal. Cop.....	58½	60½	287,575	Mackay Cos...	55¾	57*	1,100
Am. D. T.....	39*	39*	——	Mackay Cos. pfd.	61*	62½	620
Am. Loc.....	41½	45	50,000	Met. St. Ry...	17*	17*	——
Am. Loc. pfd..	92⅞	93¼	2,980	N. Y. & N.J. Tel.	100	102	14
Am. Tel. & C'bl.	50*	50*	——	Steel, com.....	35	34	487,075
Am. T. & T....	108⅜	108½*	250	Steel, pfd.....	98⅜	98½	50,350
B. R. T.....	46⅜	46	73,890	W. U. T.....	49	53	2,181
Gen. Elec.....	123½	126	8,700	West'h, com...	40¼	51¾	14,690
Hud. R. Tel...	44*	—	——	West'h, pfd....	40*	80	1,700

BOSTON.

	Mar. 23.	Mar. 31.	Shares sold.		Mar. 23.	Mar. 31.	Shares sold.
Am. Tel. & Tel.	108¾	109	——	Mass E. R. pfd.	45	47	——
Cumb'lnd Tel...	106½	105⅓	——	Mex. Tel. pfd..	—	—	——
Edison El. Ill...	203	204	——	New Eng. Tel'p.	109	109½	——
Gen. Elec.....	123	126¼	——	W'st Tel. & Tel.	6¾	7	——
Mass. Elec. Ry..	10	10	——	W. T. & T. pfd.	62½	62½	——

PHILADELPHIA.

	Mar. 23.	Mar. 31.	Shares sold.		Mar. 23.	Mar. 31.	Shares sold.
Am. Rys.....	42¾	42¾	——	Phila. Elec....	7¾	7¾	——
Elec. Co. of Am..	9	9	——	Phila. R. T....	18⅝	17½	——
Elec. Stor. B'ty.	26	28	——	Phila. Traction.	86	86	——
E. S. B'ty pfd..	—	—	——				

CHICAGO.

	Mar. 23.	Mar. 31.	Shares sold.		Mar. 23.	Mar. 31.	Shares sold.
Chicago City Ry.	155	149	——	Met. Elec. com.	17	16	——
Com.-Edison ...	91	92	——	National Carbon.	54	59	——
Chicago Subw'y.	—	18½	——	Nat. Carbon pfd.	102	107	——
Chicago Tel. Co.	120⅛	116¾	——				

*Last price quoted.
Shares sold are for week March 22-28.

a high point of 58, closing for the week at 58 asked, a gain of nearly 18 points. Shares to the number of 14,690 were traded in as compared with 3279 for the preceding week. On Wednesday Westinghouse preferred felt the uplift, and from 65 touched 73 the next day, and 76 on the following day, closing Saturday at 80 bid, an advance of 15 points. Favorable reports on the adjustment plans of the company's finances was held by some to account for the activity in these two stocks, while by others the movement was labeled as speculative. Bank clearings for the week ended March 26 totaled $2,186,056,000, which was 7 per cent under the previous week, and 27.8 per cent below the similar week in 1907. Repayment to the Treasury of some $14,000,000 of Government deposits, a large part coming from local institutions, led to a heavy cash loss, but money rates were practically unaffected. Foreign money markets were also easy. On Monday the market showed firmness and closed with but slight losses from Saturday's prices, in spite of considerable liquidation. Closing prices for leading electrical securities were as follows:

NIAGARA FALLS POWER COMPANY.—Despite liberal gains in gross and net earnings and total income, the Niagara Falls Power Company was compelled to show in its annual report for 1907, just issued, a falling off in surplus for the year. This resulted from a heavy increase in its fixed charges. Gross earnings amounted to $1,683,223, or $312,915 more than those for the previous year; expenses involved $447,076, or $120,952 more, and net earnings amounted to $1,236,147, or $191,963 more than those for 1906. Other income reached $162,535, or $83,135 more than that for the previous year, making total income $1,398,682, or $275,098 more. Fixed charges, however, amounted to $1,188,009, or $401,112 more than those for 1906, leaving a surplus for the year of $210,673, or $126,014 less than that for the previous year. The combined and condensed balance sheet, as of Dec. 31, 1907, revealed total assets of $25,103,977, or $712,950 more than the $24,391,027 recorded on Dec. 31, 1906. The company stated that it had reserved for improvements, betterments and depreciation $654,429, and that its profit and loss surplus was $469,179. It also reported that it had an excess of capital investment over capital liabilities amounting to $630,334; an excess of current assets over current liabilities amounting to $161,870, and securities of other companies, material, supplies and prepaid insurance valued at $331,404. The Niagara Falls Power Company's subsidiaries, the Cataract Power & Conduit Company, the Tonawanda Power Company, and the Niagara Junction Railway Company, had net earnings of $335,340, $49,874, and $42,953, respectively; and total surpluses of $381,152, $70,063, and $40,313, respectively. The general balance sheets of these subsidiaries showed total assets of $3,821,092, $592,304, and $547,817.

DETROIT UNITED RAILWAY.—The gross earnings of the Detroit United Railway system for February were slightly less than for the preceding month; the total net income was about $6,700 less, while the falling off in the surplus was about $15,000. For the first two months of the year the surplus after charges was $41,832, as against $70,427 for the same period of the preceding year. President Hutchins states that the decrease for the month of February is not due entirely to the prevailing business depression, but in part the climatic conditions; the weather during February was the most severe experienced in several years, resulting in marked interference in traffic and largely increased expenses. New York interests in the Detroit United Railways have characterized as absurd reports from Detroit that the company may be placed in the hands of receivers, which reports, they believe, were circulated for political effect, Since the company stopped the payment of dividends on its stock its financial condition has been improved, and while it still has a floating debt, this has been cut down within the last few months, and the balance can be handled without much difficulty.

WESTINGHOUSE STOCKHOLDERS' MEETING.—The following notice has been issued by Secretary Charles A. Terry of the Westinghouse Electric & Manufacturing Company to the stockholders, calling a special meeting, in Pittsburg, on April 29: "The board of directors of this company has called a special meeting of the stockholders to be held at the chief office of the company in the Borough of East Pittsburg, Pa., on the 29th day of April, A. D. 1908, at 10:30 o'clock a. m., for the purpose of voting for or against the increase of the indebtedness of the company by the issuing of bonds secured by mortgage or otherwise; also for or against the increase of the capital stock of the company, and also for or against the issuing of part or all of such new capital stock as may be authorized, or of stock now authorized but not issued, as preferred stock of the company, with such preferred or deferred provisions and features as the stockholders may authorize and the board of directors shall thereafter prescribe."

MONTREAL STREET RAILWAY EARNINGS.—The gross earnings of the Montreal Street Railway Company for the five months ending Feb. 29, were $1,458,464, an increase of $131,003, or 9.87 per cent over the corresponding period of the previous year. The increase in the expenses was 6.22 per cent, and of the net earnings, 17.25 per cent. The surplus was $294,963, an increase of 17.41 per cent. During the year ending Sept. 30, 1907, the company earned 9.65 per cent on the total $9,000,000 of stock authorized. Since then an additional $1,000,000 in stock and $2,000,000 of 4½ per cent bonds have been authorized. At the present rate of increase the net earnings will probably not justify 10 per cent dividends for the present year.

ITALIAN WESTINGHOUSE RAILWAY.—Through the recently incorporated Italian branch of the Westinghouse Company, the Societe Italiana Westinghouse, a large contract has been obtained by the Westinghouse interests for the electrification of a railroad in the vicinity of Como, the birthplace of Volta. The railroad has heretofore been operated by steam. This contract, together with another contract for the electrification of Italian government steam lines operating in the vicinity of Genoa, will call for the expenditure of more than $5,000,000. In order to manufacture the equipment required by those contracts, a plant costing in the neighborhood of $1,000,000 will be erected at Valdo, near Genoa.

BUTTE ELECTRIC & POWER COMPANY.—At a special meeting of the stockholders of the Butte, Mont., Electric & Power Company, the proposal of the directors to issue $5,000,000 in thirty-year 6 per cent bonds was approved. The bonds will be secured by a second mortgage on properties of the Butte Electric & Power Company and its subsidiaries, the Madison River Power Company and the Montana Power Transmission Company. The proceeds of the sale of the bonds will be applied to liquidate the floating debt of the companies and to provide them with additional working capital.

FIRST DIVIDEND OF NORTH SHORE ELECTRIC COMPANY.—The directors of the North Shore Electric Company have declared an initial dividend of three-quarters of 1 per cent. The company will issue $530,000 new stock at par; each stockholder paying in full by May 1 will receive 20 per cent of his holdings in treasury stock as a bonus. The officers have been re-elected.

WESTINGHOUSE ELECTRIC.—The time set for the consent of the stockholders to the reorganization plan of the Westinghouse Electric & Manufacturing Company expired on Monday, and an extension of sixty days was announced. Amendments to the plan which will greatly facilitate its adoption by all the stockholders, will be agreed upon.

CHICAGO SUBWAY.—All the large holders of tunnel bonds have assented to an exchange for subway bonds. This paves the way both for the lease to the Automatic Telephone Company and also for resumption of the Edison negotiation, which it is expected will shortly be resumed.

CHICAGO TELEPHONE MERGER.—The merger of the Automatic Electric and Strowger Telephone Companies has been ratified by stockholders of both the companies. The combined company is arranging the final terms for the use of the entire subway-tunnel system for its circuits.

NEW YORK & NEW JERSEY TELEPHONE.—The regular quarterly dividend of 1¾ per cent, payable April 15, to stock of record April 4, has been declared by the directors of the New York & New Jersey Telephone Company.

MANILA ELECTRIC REGULAR DIVIDEND.—The regular quarterly dividend of 1 per cent, payable April 1, has been declared by the directors of the Manila Electric Railroad & Lighting Corporation.

COLORADO TELEPHONE REGULAR DIVIDEND.—The regular quarterly dividend of 1¾ per cent, payable April 15, has been declared by the directors of the Colorado Telephone Company.

BELL TELEPHONE OF MISSOURI DIVIDEND.—The directors of the Bell Telephone Company of Missouri have declared the regular quarterly dividend of 2 per cent.

MEXICAN LIGHT & POWER COMPANY PROGRESS.—The report of the Mexican Light & Power Company, recently issued, shows that the investments of that company in Mexico have been more than $40,000,000, and the work of adding to the great plant and extending the business to other parts of the republic is still in progress. During the last year a total of $2,475,331 gold was expended on capital account, of which more than $1,000,000 was spent in the work of completing the hydro-electric plant at Necaxa. About $1,000,000 was spent on distribution lines in Mexico City and the Federal District. The sum of $250,000 was expended during the year on the installation of the second hydro-electric plant, which up to Dec. 31, 1907, had cost $688,000 gold. A provisional dam has been constructed at Los Reyes and a tunnel driven to connect the Laguna reseryoir with the Los Reyes reservoir. The Laguna dam has been raised to a height that will provide a storage capacity of 30,000,000 cu. m. of water. The great dam at Necaxa is being built at the rate of about 73,000 cu. m. a month, more than 337,000 cu. m. of material already having been laid, and in all about 1,634.000 cu. m. of material will be used. In addition to the large amount of current which the company is supplying to Mexico City, towns of the Federal District, the city of Puebla and mining concerns in El Oro, the demand is far greater than the supply. The company has tentative contracts for supplying installations amounting to 3000 hore-power, exclusive of the contract which the company has made with the federal government, by the terms of which 3000 horse-power is to be furnished to operate the pumps of the water-works and drainage systems of the city. This contract will probably be begun the latter part of this year. Many transmission lines reach out in all directions from the Necaxa plant, the longest being 175 miles. It is planned to supply all the demand for power within a radius of 200 miles or more from the Necaxa plant.

GENERAL ELECTRIC-WESTINGHOUSE MERGER RUMOR DENIED.—The perennial rumor to the effect that the General Electric and Westinghouse companies are to be merged, duly made its appearance bearing the date of March 29, and has once more been denied by officers of both companies. This time the tale comes from Chicago, and says that if the plans are carried out, which it alleges are afoot, an electrical company will be formed with a capitalization of more than $100,000,000, and goes on to state that negotiations have been going on since the Westinghouse companies went into receivers' hands, although matters were not pushed with vigor until within a few weeks. "Several meetings have been held between the principals of both concerns," so runs the tale, "but from what can be gathered, the largest Westinghouse interests are reluctant to give up the property which they hope to take out of the receivers' hands. But it is said that they have not rejected the offer of the General Electric Company. If their own plans for rescuing the company fail," the romance appropriately concludes, "there will be time enough to accept the offer." A director and officer of the General Electric Company said that there was no foundation for the report, that no conferences looking to consolidation had been held, and that such a merger was neither practical nor contemplated. Officers of the Westinghouse Company smiled when questioned, and said that the report was not worth a denial.

NORTHERN OHIO TRACTION & LIGHT COMPANY.—The report for February of the Northern Ohio Traction & Light Company, shows gross earnings of $119,301, as compared with $116,858 for February, 1907, and expenses of $78,466 as compared with $72,710 for the same month in the preceding year. The net for the month was $40,835, with charges of $42,405, leaving a deficit of $1,570, as compared with a net of $44,148 for February of a year ago, charges of $41,400, and a surplus for the month of $2,748. The two months gross was $246,426, as compared with $242,049, for the same two months in 1907, and the expenses, $160,358 and $152,291 respectively, in the two periods compared, leaving a two months net for 1908 of $85,068, as compared with a two months net in 1907 of $89,758. Deducting charges leaves a two months' surplus of $161 for 1908, as compared with a two months surplus of $7,019 for the same two months in the previous year.

TWIN CITY RAPID TRANSIT REPORT.—The report of the Twin City Rapid Transit Company showed for February gross receipts of $453,944, as compared with $419,802 for February, 1907, and expenses of $253,643, against expenses of $217,468 for the same period of the previous year, leaving a February net of $200,301, as compared with the February net for 1907 of $202,334. Charges, taxes and preferred dividend amounted to $122,789, leaving a surplus for February, $77,512, a decrease from the $87,076 surplus of February, 1907. The gross receipts for the two months was $923,835, compared with $876,639 for the corresponding two months of the previous year, and expenses were $511,844, as against $460,565 of the same two months of the previous year. The two months net were $411,-491 and charges, taxes and preferred dividend $244,744, leaving a surplus of $167,247, as compared with $185,557 for the corresponding two months for 1907.

TOLEDO RAILWAY & LIGHT COMPANY'S FEBRUARY REPORT.—The report for February shows an increase in all items except the expense account, which shows a decrease over the same period of the previous year. February's gross is given as $207,878, an increase of $8,177 over February last year. Expenses were $116,301, a decrease of $2,858, leaving a net of $91,577, an increase of $11,035 over February of the previous year. The total income was $92,397, against $81,619 of last year, and the surplus for February, $23,948, or a $5,483 increase over February, 1907. The two months gross was $424,839, and the expenses were $241,389, leaving a net for the two months of $183,450, which represents an increase of $12,046. The total income was $185,048, which after deducting charges and taxes leaves a surplus for the two months of $47,995, against $47,638 of February, 1907, an increase of $357.

HARRIMAN BUYS TROLLEY LINES.—Dispatches from Los Angeles state that the entire electrical interests of Henry E. Huntington have been taken over by E. H. Harriman, and that Mr. Huntington has retired permanently from the electrical field. This means that Mr. Harriman will control the Pacific Electric Company, the Los Angeles-Pacific Company, the Los Angeles Railway Company, the Los Angeles Interurban Railway Company, and the Los Angeles & Redondo Railway Company, one of the largest and most complete trolley systems in the world. Mr. Harriman also controls the Pacific Light & Power Company. The transfer involves a sum in the neighborhood of $50,000,000, and means the control of the trolley lines of Southern California, in addition to a majority of railroad lines which have operated as feeders to the vast Harriman system for many years.——Since the above was put into type, Mr. H. E. Huntington has denied that there is any truth whatever in the report that he has transferred his large interests in electric railways in California to the Southern Pacific or to Mr. Harriman.

PORTLAND ELECTRIC COMPANY.—The report of the Portland (Me.) Electric Company shows a growth in business of 10 per cent during January over the corresponding period of last year. The earnings for January, 1908, were $29,647.87 against $26,988.47 for January, 1907, an increase of $2,659.40. Gross earnings for the year ended Jan. 31, 1908, compared with 1907, as follows: 1908, $300,477.69; 1907, $283,268.65.

KNOXVILLE RAILWAY & LIGHTING REGULAR DIVIDEND.—The regular quarterly dividends of 1 per cent on the common stock and 1½ per cent on the preferred stock, both payable March 31, have been declared by the directors of the Knoxville Railway & Lighting Company.

CITY RAILROAD OF DAYTON REGULAR DIVIDEND.—The directors of the City Railroad of Dayton have declared the regular quarterly dividend of 1¾ per cent on the common stock, and 1½ per cent on the preferred stock, payable April 1.

MEMPHIS STREET RAILWAY REGULAR PREFERRED DIVIDEND.—The directors of the Memphis Street Railway Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable March 31.

CENTRAL & SOUTH AMERICAN TELEGRAPH DIVIDEND.—The directors of the Central & South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable April 9.

PUBLIC SERVICE CORPORATION QUARTERLY DIVIDEND.—The directors of the Public Service Corporation of New Jersey have declared the regular quarterly dividend of 1 per cent, payable March 31.

SYRACUSE RAPID TRANSIT REGULAR DIVIDEND.—The directors of the Syracuse Rapid Transit Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1.

INTER-MET BOND ISSUE.—At a special meeting of the stockholders of the Interborough Rapid Transit Company, held last Saturday, the proposal of the directors to execute a mortgage for $55,000,000 on the company property, against which bonds are to be issued, was approved. The consent of the trustee for the Interborough-Metropolitan bonds, against which $33,912,800 of the Interborough Rapid Transit Company's total $35,000,000 of capital stock is held, has also been obtained for the proposed bond issue. It is the intention of the company, provided the outlined plan is carried on, to issue $18,000,000 of bonds to refund and extend the $15,000,000 of 4 per cent notes which mature on May 1, and to put out $12,000,000 of these new bonds to discharge other outstanding indebtedness of $10,352,726. If it is found difficult to market the proposed bonds the company may issue short time notes with the bonds as security. Action by the Public Service Commission on the application of the Interborough Rapid Transit Company for permission to issue the bonds was postponed until Monday. At the hearing C. H. Venner protested against the proposed Interborough mortgage, but Chairman Willcox of the commission declined to have his objections recorded at that time, and instructed him to submit in writing to the commission any arguments which he might have against the approval of the bond issue. Former Judge Thomas L. Feitner appeared as a representative of security holders of the Interborough-Metropolitan Company, and requested that his appearance be noted. He stated that if this new bond issue should take precedence over the Interborough-Metropolitan securities he would file objections. The $3,000,000 of 60-day notes for which the company is reported to be negotiating were said, in banking circles, to represent merely a shifting of some bank loans to a new form pending the execution of the sale of $20,000,000 bonds or a similar amount of short-termed notes secured by them as collateral, to make up obligations matured about May 1. Whether the bonds will be sold or the financing arranged by short-term notes, based on the bonds as collateral, has not been decided, although it is said the chances are in favor of two-year notes.

BUFFALO INTERNATIONAL TRACTION REPORT.—The annual report of the International Traction Company, of Buffalo, for the fiscal year ended Dec. 31, 1907, gives the gross income as $5,445,070 as compared with $5,024,298 for the preceding year, and expenses of $3,652,602 as compared with $3,146,273 for 1906, leaving a net of $1,792,468 and decrease over the preceding year of $85,557. Deducting charges, there is a surplus of $312,260, a decrease of $152,593. The surplus is equal to 2.1 per cent on the $15,000,000 capital stock. Notwithstanding the financial crisis, said President Henry J. Pierce, the gross earnings of the system for 1907 showed an increase of $420,771 over 1906. The decrease in the surplus was due to higher operating expenses, taxes and interest. During the year the car mileage was increased 1,779,790 miles, equivalent to 9 per cent, and in that time $525,327 was expended for repaving and relaying tracks with heavy rails, etc., and $865,578 for additions to equipment, track and buildings. These expenditures were charged respectively to the fund for depreciation and to capital account.

TO INSPECT NORTH AMERICAN PROPERTIES.—The following announcement was issued last week from the offices of Spencer Trask & Co., the banking firm at Pine and William streets: "About thirty-five representatives and correspondents of the banking firm of Spencer Trask & Co. will leave New York Sunday morning, March 29, to visit the cities of Cleveland, Detroit, Chicago and Milwaukee. Primarily, the object of the trip is to enable the party to familiarize themselves at first hand with the properties of the Detroit Edison Company, the Milwaukee Electric Railway & Light Company, and the Milwaukee Light, Heat & Traction Company, which are among the important public utility corporations under the supervision and management of the North American Company. The party will also go over the properties of the Cleveland Electric Illuminating Company. For many years Spencer Trask & Co. have been identified with the management of these and similar properties, the securities of which are largely held by institutions and individuals both in this country and in Europe."

RUMORED WIRELESS MERGER DENIED.—The reports current of late to the effect that the Marconi Wireless Telegraph Company and the United Wireless Telegraph Company are considering plans of consolidation were denied last week by officers of both companies. Three bills regulating the wireless service are at present pending before Congress, all of which are considered by the wireless companies to be inimical in their present form to wireless interests, and the fact that representatives from both companies have been at Washington looking after their companies' affairs is suggested as the cause of the report that plans of consolidation were on foot.

BELL TELEPHONE COMPANY OF BUFFALO.—The annual report of the Bell Telephone Company of Buffalo, for the year ended Dec. 31, 1907, gives gross earnings of $1,709,679, as compared with $1,573,547 for 1906, and expenses of $1,072,710, against $1,001,924 for the previous year. The net earnings, which are equal to 7.8 per cent on the $8,122,700 capital stock, were $636,969, against net earnings of $571,623 for 1906. Dividends of $474,414 were declared, leaving a balance of $162,555 against a balance of $136,023 for the previous year. The number of stations of the company was given as 54,575, an increase during the year of 1705.

BUTTE ELECTRIC & POWER EARNINGS.—In spite of the fact that work in the Butte copper mines has been practically stopped since October, and all Amalgamated properties shut down with the exception of the Boston & Montana mine, the earnings of the Butte Electric & Power Company for the four months ended Jan. 31, 1908, were $228,394, an increase of $35,927 over the corresponding period of the previous year. The surplus, after deducting interest charges and sinking fund, was $125,605, an increase of $15,023.

ST. LOUIS ELECTRIC & POWER COMPANY REPORT.—For the year ended Dec. 31, 1907, the Union Electric Light & Power Company, of St. Louis, reports gross earnings of $2,855,417, an increase of $612,936 over the previous year. Expenses, including taxes, were $1,116,562, a decrease of $72,241 from 1906, and net earnings were $1,738,855, a gain of $685,177. Interest and miscellaneous expenditures were $981,005, or $466,707 more than for the previous year, leaving a surplus of $757,850, or $218,470 more than for 1906.

UNITED ELECTRICAL OPTIMISM.—T. I. Jones, sales manager of the United Electric & Power Company, is one of the "advance agents" of optimism. He says, "Optimism is the motto of this office. We don't recognize any financial depression here and there are no calamity howlers in our outfit. There has been no month during the last half year wherein we did not write more business than during the corresponding month of the previous year."

ELECTRIC STORAGE BATTERY CUTS DIVIDEND.—The directors of the Electric Storage Battery Company have declared a dividend at the rate of 1 per cent for the quarter on both the preferred and the common stock. This is a reduction of ¼ per cent from the disbursements of last quarter.

UNITED RAILWAYS INVESTMENT COMPANY NOTE ISSUE.—The United Railways Investment Company will issue $3,500,000, 6 per cent, serial notes, maturing from 1909 to 1917. The proceeds of the issue will be used to take up the floating debt of the United Railroads of San Francisco.

PUGET SOUND ELECTRIC RAILWAY COMPANY MEETING.—The annual meeting of the stockholders of the Puget Sound Electric Railway Company will be held on April 21. The books of transfer will be closed April 1 and will reopen April 22.

GENERAL ELECTRIC STOCKHOLDERS MEETING.—The annual meeting of the stockholders of the General Electric company will be held at 12 o'clock, May 12, in Schenectady. The transfer books will close on April 11 and will reopen on May 13.

PENNSYLVANIA BELL TELEPHONE REGULAR DIVIDEND.—The regular quarterly dividend of 1½ per cent, payable April 15, has been declared by the directors of the Bell Telephone Company, of Pennsylvania.

MEXICAN TELEGRAPH COMPANY REGULAR QUARTERLY DIVIDEND.—The regular quarterly dividend of 2½ per cent, payable April 16, has been declared by the directors of the Mexican Telegraph Company.

BANGOR RAILWAY & ELECTRIC COMPANY DIVIDEND.—The directors of the Bangor Railway & Electric Company have declared the regular quarterly dividend of 1¼ per cent.

MASSACHUSETTS LIGHTING REGULAR DIVIDEND.—The trustees of the Massachusetts Lighting Company have declared the regular quarterly dividend of 1½ per cent, payable April 15.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

PINE BLUFF, ARK.—Contracts have been awarded by the Pine Bluff Light & Water Company for the construction of its power plant and reservoir, in connection with the new plant the company is erecting in this city. The Seldon-Beck Construction Company, of St. Louis, Mo., was awarded the contract for the construction of the power plant.

BERKELEY, CAL.—Arrangements are being made by the Bay Counties Power Company to remove its high-tension transmission lines from Grove and Rose Streets in Berkeley. The company is securing the right of way for its pole line on the east side of the Berkeley Hills, to transmit electricity from the main plant in Oakland to the substation in Berkeley. Frank A. Leach, Jr., is manager.

CHICO, CAL.—The City Trustees are contemplating the construction of a municipal electric light plant, and will engage an engineer to make an estimate of the cost of the same.

COLUSA, CAL.—It is reported that the Colusa Irrigation Canal Company is negotiating for a pumping plant to be operated by a 100-hp engine or electrical power. M. J. Biggs is president of the company.

FRESNO, CAL.—The San Joaquin Light & Power Company has made arrangements with Thomas Williams, David Bavo and August Marin to install and maintain for them a 15-hp electric motor on canals occupied by them.

LODI, CAL.—The City Trustees have voted a bond issue of $76,000 for a light and power plant and water works system.

MAGALIA, CAL.—The operation of the new power plant of the P. B. Steifer Mining Company will be started about April 1. The plant will have an output of about 275 kw and will furnish electricity to operate the mines of the company. The California Gas & Electric Company, until recently, furnished electrical energy for operating the mines.

PLACERVILLE, CAL.—Benjamin C. Celio has filed a notice of appropriation of 2000 cu. in. of water of the Cosumnes River, to be used for milling, mining and power purposes.

SAN FRANCISCO, CAL.—The United Railroads of San Francisco have completed arrangements for lighting Market, Valencia and Sutter streets, in accordance with its promise made shortly after the fire. A contract has been awarded for the ornamental poles, which will be erected about June 1. The cost of the work, including the arc lamps, is estimated at $100,000. The company also contemplates the retracking of Market Street from Sansome to Twelfth Streets and that of McAllister Street. Charles N. Black is general manager.

WATSONVILLE, CAL.—The Board of Aldermen has granted the Ocean Shore & Eastern Railway Company a franchise to construct and operate an electric railway through this city.

WOODLAND, CAL.—The Pacific States Telephone Company is erecting a new toll line from Woodland to Colusa Junction. The company will rebuild many portions of its line in the northern part of the state.

EUREKA, COL.—G. H. Scott has appropriated 600 cu. in. of water flowing in the Old Mill Creek for the purpose of supplying water in Trinidad and to generate electricity.

DARIEN, CONN.—The citizens are contemplating establishing a municipal electric light plant. A committee has been appointed to investigate the matter and report at the annual town meeting.

HARTFORD, CONN.—The contract for installing the lighting equipment on the new bridge across the Connecticut River has been awarded by the Board of Commissioners of the Connecticut River Bridge and Highway District to the Rice & Baldwin Electric Company, of Hartford, the work to be completed by May 1. The plans call for 88 tungsten lamps of 100 cp each.

MIDDLETOWN, CONN.—The Southern New England Telephone Company is planning to construct more underground conduits in the business portion of the city. The company is building a new exchange building, which will be completed about Aug. 1. The common battery system will be installed.

WALLINGFORD, CONN.—The Board of Electrical Commissioners has adopted a new schedule of rates for electricity furnished under the meter system, which will take effect from April 1, as follows: Schedule A—Factories, 10 cents per kw-hour; connections made with isolated plants, 10 cents per kw-hour, plus a charge of $5 per year per kilowatt transformer output, same to be owned by the consumer. Schedule B—Places of business, rooms, halls, churches, schools, etc.: First 100 kw-hours, 10 cents per kw-hour; next 200 kw-hours, 8 cents per kw-hour. Schedule C—Residences, heating and small motors up to 1 hp, from 10 cents to 8 cents per kw-hour. Schedule E—Flat rate for sign lighting and yearly contract; 2-cp lamps: 9 cents per month; 4-cp lamps, 16 cents per month; same to burn six nights per week, one hour after sunset until 10 p. m. Special prices for day power service for one-half horse power and over. The minimum charge for all schedules is $1 per month. Prepayment meters will be installed free; the rate charged for energy consumed will be 11 cents per kw-hour. A. L. Pierce is superintendent.

WASHINGTON, D. C.—Bids will be received until April 14 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal.: Schedule 918—One 10-hp motor. Puget Sound, Wash.: Schedule 917—2000 ft. single conductor; about 19,000 ft. twin conductor; sockets and interior fittings; 20,000 ft. double conductor silk; 10,000 ft. bell wire, and 5000 ft. signal cable and light fixtures. Schedule 919—11,500 ft. seamless brass voice tubing. Applications for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster General, U. S. N.

ATHENS, GA.—The Athens Electric Railway Company has recently placed orders for additional equipment for its power house, including a 1000-kw Allis-Chalmers turbine, boilers of 290 horse-power, Blake condensers and a 15-ton crane. C. D. Flanigan is manager.

SYLVESTER, GA.—At an election held March 18 the citizens voted to issue $10,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system. C. W. Hillhouse is Mayor.

CHICAGO, ILL.—President R. R. McCormick, of the Chicago Drainage Board, has applied to Mayor Busse for permission to use the city's poles and conduits for the transmission of electricity, which the board wishes to furnish to private consumers.

LAWRENCEVILLE, ILL.—The Lawrenceville Water & Light Company is making extensive improvements and changes in its plant, including the installation of a 50-kw, 2200-volt, single-phase alternator and an 85-hp gas engine, for which contracts have been placed. The entire distribution system will be changed from direct to alternating current. The company expects to extend its transmission lines to two neighboring towns, a distance of about 10 miles, and also contemplates installing more generating machinery before the coming winter. C. Gough is manager.

MANITO, ILL.—It is stated that the city has purchased the interest of T. H. Smith in the Manito electric lighting plant. Work on the completion of the system will be pushed as rapidly as possible.

MILLSTADT, ILL.—The capital stock of the West Side Telephone Company has been increased from $2,700 to $4,500.

CANAAN, IND.—The Farmers' Mutual Telephone Company, which purchased the lines of the Green system in Green County, is erecting its lines and will install an exchange in Canaan.

CROWN POINT, IND.—The Crown Point Telephone Company is planning to move its exchange and will install a new switchboard.

FORT WAYNE, IND.—Plans are being made by the Home Telephone & Telegraph Company for making extensive additions to its cable system in Fort Wayne.

LIGONIER, IND.—Sealed proposals will be received by the President and City Council until April 21 for furnishing material and constructing an electric light plant for this city. The work includes a power plant of either steam, with Corliss engine, or a gas engine and producer, or oil engine; one 100-kw alternating-current generator, switchboard, pole line, wiring and 48 street arc lamps. Also furnishing meters and transformers. The power plant will be installed in water works building owned by the city, on foundations to be built by the contractor. Plans and specifications are on file with the city clerk, or may be seen at the office of the engineer, A. J. Hammond, at South Bend, Ind. For further information address R. E. Jeanneret, city clerk.

PACKERTON, IND.—The New Metal Telephone Company is contemplating extending its lines to Packerton, and agrees to install a switchboard if the citizens will agree to guarantee 100 telephones to connect with it.

SOUTH BEND, IND.—The Chicago, South Bend & Northern Railway Company has commenced construction work on its extension between South Bend and La Porte, Mich. Electricity for operating this railway will be furnished by the Indiana & Michigan Electric Company. Substations along the extension west will be built at Lydick, Rolling Prairie and La Porte.

SULLIVAN, IND.—A. S. Courtwright will apply for a franchise for street and residential lighting in this town.

WATERLOO, IA.—The Waterloo, Cedar Falls & Northern Railway Company is contemplating extending its lines to Westfield and other outlying districts of the city. The cost of the work is estimated at about $75,000.

CAWKER CITY, KAN.—A mutual telephone company has been organized in this city, and will either install a new system or purchase the plant of the company now operating in the town. The company already has $7,000 capital pledged.

NATIONAL MILITARY HOME, KAN.—Bids will be received until April 4 at the office of the Treasurer, Western Branch, N. H. D. V. S., National Military Home, Kan., for furnishing and installing one direct-connected engine and generator in the electric light plant. Copies of specifications, together with blank proposals and other information, may be had on application to Major W. W. Martin, Treasurer.

WELLINGTON, KAN.—The new municipal electric light has been completed and placed in operation. The new equipment, consisting of new dynamos, engines, boilers and switchboard was installed by the Allis-Chalmers Company, Milwaukee, Wis. The system has been changed from single-phase to the two-phase system.

JACKSON, KY.—The Jackson Electric Light & Power Company has been reorganized under the name of the Jackson Electric Light & Hydraulic Manufacturing Company by L. P. Gunn, A. D. Moore and J. W. Norwood, all of Lexington. The new company will operate the local electric light plant, which will resume operations at once. The company will also operate water works and manufacture ice. The capital stock of the company is fixed at $20,000.

LA CENTER, KY.—The Ballard County Independent Telephone Company has awarded a contract to the Western Telephone Manufacturing Company for furnishing a switchboard and telephone boxes and supplies for its system. The cost of the system is estimated at $2,500.

OLA, KY.—The Sergesth-Ola Telephone Company contemplates building new lines from Colby to Hilliard, and from Ola to Thornton. J. S. Webb is manager.

PIKEVILLE, KY.—The capital stock of the Eastern Kentucky Home Telephone Company has been increased from $3,000 to $5,000, the proceeds to be used for extending its line to Shelby Creek and other improvements to its system.

TOMPKINSVILLE, KY.—A company has been organized to construct telephone lines in Barren and Monroe counties. The central exchange will be located in Tompkinsville.

NEW ORLEANS, LA.—Preparations are being made by the Cumberland Telephone & Telegraph Company to change its present telephone system in this city to the common battery system.

BUCKSPORT, MAINE.—It is reported that the Penobscot Bay Electric Power Company is planning to construct two more power houses in this section early in the spring. The company owns the Lock & Sluice Company's privileges at the falls and one other location, which may be developed this summer.

DEXTER, MAINE.—The Sebasticook Power Company, of Pittsfield, is contemplating extending its transmission lines to Dexter, the cost of which is estimated at $14,000. The company proposes to make some arrangement with the local company, or any other company that may be organized, to furnish electrical energy for lamps and motors. The town is anxious to secure an all-night lighting service, which the local plant is unable to furnish at present.

DEXTER, MAINE.—The citizens voted to appropriate the sum of $1,075 for street lighting, and authorized the Lighting Commission to make a contract with the Dexter Electric Company at the lowest cost.

HAMPDEN, MAINE.—It is understood that a number of Hampden citizens are interested in the purchase of a water power near the town, where it is proposed to erect an electrical power plant to furnish the town and cottages with electricity for lamps and motors. The summer residents are said to be interested in the project.

TURNER, MAINE.—The Auburn & Turner Railroad Company is about to place contracts for the construction of an extension to its lines, about two miles in length.

CONOWINGO, MD.—The Senate has passed the bill amending the charter of the Susquehanna Power Company to conform to the desires of the Pennsylvania Railway Company, which will enable the former to enlarge the scope of its work when it is ready. By the terms of the agreement between the power company and the railroad, the former, when prepared to go on with the work, will relay the tracks of the railroad company, so that travel will not be interrupted at any time.

FEDERALSBURG, MD.—The Senate has passed the bill incorporating the Idlewild Electric Light & Power Company.

HUDSON, MASS.—The Municipal Light and Power Department is considering the proposition of furnishing electricity for lamps in Stow and Berlin. The department is now furnishing electricity in Gleasondale for lamps and is seriously considering the proposition to extend its lines to Stow, but it is doubtful if the commissioners will take up the Berlin project unless the town erects its own distributing system.

MELROSE, MASS.—A committee has been appointed to investigate the management of the municipal electric light plant and to consider the question of purchasing new equipment or the purchase of electricity for lighting. The members of the committee are George M. Poland (chairman), Edwin C. Miller, F. J. Henkel, Thomas E. Dwyer, John Flanley, Charles N. Winship, G. H. Stowell, S. K. Hamilton and J. T. Cooper.

METHUEN, MASS.—The citizens have voted to appoint a committee to investigate the matter of street lighting and secure prices for the different methods of illumination and make a report not later than May 2.

UPTON, MASS.—At a recent town meeting the citizens voted to appoint a committee to investigate the question of lighting the streets of the town with electricity. The streets are now lighted with kerosene lamps.

WESTFIELD, MASS.—Plans are being made by the managers of the municipal electric light plant to install two new boilers to replace the ones now in use at the plant, in order to comply with the state law. The work will require an appropriation of between $5,000 and $6,000.

DETROIT, MICH.—The City Council has decided to construct an underground conduit system, and has instructed the light, fire and police departments to prepare estimates of the cost of their part of the work. The cost of the work for the three departments is estimated at $113,910.

NILES, MICH.—The large dam erected in the St. Joseph River at Buchanan, which had been weakened by recent floods, was carried away March 21. The dam was 500 ft. long and cost $250,000. It furnished power for operating the electric plants at Niles, Mich., and South Bend, Ind., and was owned by Charles A. Chapin, of Chicago, Ill.

COTTAGE GROVE, MINN.—Plans are being made to build another telephone line from Lake Shore to Cottage Grove.

MINNEAPOLIS, MINN.—The Deuel County Telephone Company, of North Dakota, has been granted permission by the Secretary of State to do business in the State of Minnesota.

LOUISVILLE, MISS.—The capital stock of the Kirk Telephone Company has been increased from $2,000 to $10,000.

SMITHVILLE, MO.—The citizens have voted to issue bonds for the construction of a municipal electric lighting plant.

ST. LOUIS, MO.—The substation of the Union Electric Light & Power Company was destroyed March 20 by an explosion, causing a loss of $25,000.

WEST PLAINS, MO.—A company has been organized to install a large electric power plant at the Samuel Hammond Mill, on the North Fork River, in Ozark County, about 20 miles from the city. It is proposed to erect a dam at this point and transmit electricity to the city. The company, it is said, will submit a proposition to supply electrical energy to the municipal electric light plant at a much lower cost than the city can operate the plant. C. H. Martin, of Doniphan; Thomas D. Martin, C. K. Martin and Samuel Hammond are interested in the project.

FORSYTH, MONT.—The Forsyth Electric Light & Telephone Company is contemplating extending its telephone line to Miles City.

HELENA, MONT.—Announcement has been made that the patents for the Baker & Burtwell electrical ore treatment have been transferred to the Montana Metallurgical Company, of Helena, a holding company, and that plans have been made for the erection of a plant this summer at Helena or East Helena, with an output of from 100 to 150 tons of ore a day. This is the first commercial plant erected under this process, and it will be built on the unit system, so that it can be enlarged from time to time, as conditions warrant. An option on the process for this district has been given by the Montana Metallurgical Company, and a selection of a site for a plant is now being made.

WINSTON, MONT.—Announcement has been made that a power plant will be constructed on Deep Creek, in Broad Creek, in Broadwater County, in the Big Belt Mountains. It is proposed to supply electricity in the Winston and Radersburg districts and in Townsend for mining and other enterprises, and also for dredging operations on the Missouri River. It is stated that a large number of contracts have been secured.

HAVELOCK, NEB.—The Plattsmouth Independent Automatic Telephone Company contemplates the entire rebuilding of its system in this city.

GENOA, NEV.—Adolph Dressler, who lives a few miles below here, has decided to install an electric power plant to furnish electricity for lamps and motors.

GOLDFIELD, NEV.—The County Commissioners have sold the franchise rights for a telephone and telegraph service from Schurz to Rawhide to Attorney George Springmeyer. The Rawhide Light & Power Company has petitioned the County Commissioners for a franchise to operate a light and power plant.

LOVELOCK, NEV.—Negotiations have been closed between the Lovelock Light & Power Company and Stephen R. Young whereby the power company leases for a term of 25 years the entire flow of water in the Humboldt River at the Young Ranch, near Lovelock. The plans of the power company call for the building of a 10,000-volt transmission line to the town limits, where a substation will be built.

CONTOOCOOK, N. H.—The citizens have voted to renew the contract for street lighting with the Contoocook Electric Light Company at the rate of $12.50 per lamp per year.

TILTON, N. H.—The question of substituting the present arc-lamp street lighting system for incandescent lamps is now under consideration. The town now pays $80 per lamp per year for arc lamps of 1200 cp and $15 per year per lamp for 32-cp incandescent lamps.

JERSEY CITY, N. J.—The Mutual Benefit Electric Light & Power Company has filed an application with the city clerk for a general franchise to furnish electricity in this city for lamps and motors. In consideration for a franchise the company offers to furnish electrical energy at a maximum charge of 8 cents per kw-hour, with 5 per cent discount for prompt payment. The company also offers to place all its wires underground and to pay to the city 5 per cent of its gross earnings each year. The officers of the company are: James M. Seymour, Jr., of Newark, president; Richard S. Carrick, secretary, and John F. Nagle, treasurer.

TRENTON, N. J.—A bill has been introduced in the Legislature to permit the boards of freeholders to construct and operate lighting plants and furnish electricity for lighting to any municipality within the county limits. In order to supply funds the board is authorized to issue county bonds to an amount not exceeding $200,000.

ASBURY PARK, N. J.—Harry J. Rockafeller, of Sunset Hall, has petitioned the Council for an electric light and power franchise.

SOUTH ORANGE, N. J.—The Senate has passed the bill authorizing the city of South Orange to construct or acquire an electric light or gas plant.

BABYLON, L. I., N. Y.—The Public Service Commission has authorized the Babylon Electric Light Company to issue capital stock to the amount of $30,000, the proceeds to be used for extensions and improvements.

CANTON, N. Y.—The Northern Power Company has entered into a contract with the Canton Electric Light & Power Company, whereby the Northern Power Company will supply electrical energy from its power plant at Hannawa Falls to operate the local system for a long term of years. A transmission line will be erected from the power plant to the electric light station in Canton.

LOCKPORT, N. Y.—The Niagara County Home Telephone Company is making arrangements to erect a new telephone exchange in this city to cost about $50,000.

NEW YORK, N. Y.—Bids will be received until April 6 by C. B. J. Snyder, superintendent of school buildings, for installing electric equipment in the addition to and alterations in Public School No. 16, on Matilda and Catherine Streets, Borough of Bronx.

NEW YORK, N. Y.—Bids will be received until April 6 by the president of the Board of Trustees of the Bellevue and Allied Hospitals Department, Twenty-sixth Street and First Avenue, Borough of Manhattan, for furnishing and setting lighting fixtures in pavilions A and B of the new Bellevue Hospital, Borough of Manhattan. John W. Brannan is president of Board of Trustees.

FORT ANN, N. Y.—Plans are being made by the Kane's Falls Pulp Company to install an electric light and power plant in the old pulp mill at Kane's Falls. The plant will have an output of 1500 kw and will furnish electricity for lamps and motors in Fort Ann, Glens Falls and other nearby places. The company controls the entire watershed supplying the Kane's Falls power, and proposes to build a larger dam at Kane's Falls in the near future. Eugene L. Ashley is president of the company.

ROUND LAKE, N. Y.—The Village Trustees are considering the question of lighting the streets of the village with electricity. A committee, consisting of Joseph McKay, William H. Mann and E. H. Lisk, has been appointed to investigate and take action on the matter. It is stated that Mr. Warren, of the Clifton Park Company, has submitted a proposition to furnish electricity to operate the system.

WATERTOWN, N. Y.—The Public Service Commission has granted the Watertown Light & Power Company permission to issue bonds to the amount of $200,000, bonds to be sold at not less than 80 per cent of their value, and $102,500 stock at par. It is provided in the order that any excess in the proceeds of this issue of bonds which may be realized from the sale thereof shall operate to reduce to the extent of such excess the amount of capital stock authorized to be issued.

ASHEVILLE, N. C.—Final surveys are being made for the proposed electric railway from Asheville to Hendersonville.

ROUGEMONT, N. C.—C. W. Harris, W. Cochran and H. L. Carver are contemplating the construction of an electric power plant and are organizing a company for that purpose. It is said that they propose to erect a number of manufacturing plants.

STATESVILLE, N. C.—The Turner Mills Company, of East Munbo, N. C., is constructing a power plant and cotton mill. The dam, which is 1000 ft. in length, will develop about 350 hp for transmission by electricity to operate the mills. The company is capitalized at $250,000.

BELLE CENTER, OHIO.—The Village Council is contemplating making improvements and additions to the municipal electric light plant, which will involve an expenditure of about $5,000.

COLUMBUS, OHIO.—Plans are being contemplated by the Columbus, Urbana & Western Traction Company for continuing its railway through Plain City, Marysville and Kenton, where it will connect with the Lima & Toleda Traction Company, direct to Toledo. It is also proposed to construct an extension to Urbana.

FREMONT, OHIO.—The City Council has adopted a resolution providing for the removal of all telegraph, telephone and electric light wires within the business district of the city and have them placed in underground conduits.

BARTLESVILLE, OKLA.—Contracts have been awarded by the Bartlesville Interurban Railway Company for the construction of an electric railway from Bartlesville as follows: For overhead construction, tracklaying and installation of machinery in power house, to the Freeborn Engineering & Construction Company, of Kansas City, Mo.; for power house equipment, including generators, engines, pumps and boilers, to the John A. Stewart Electric Company, of Cincinnati, Ohio.

STILLWATER, OKLA.—At an election to be held April 7 the citizens will vote on the proposition to issue $7,000 in bonds for extensions to the electric light plant.

WAURIKA, OKLA.—The city has granted a franchise to M. Griffin O'Neil, of Dallas, Tex., to construct and operate an electric light plant. The cost of the plant is estimtated at $10,000.

LEBANON, ORE.—Plans are being made by the Lebanon Electric Light & Water Company for extensive improvements to both the water and light plants. J. S. Hughes is manager.

HARRISBURG, PA.—The Donora & Eldora Street Railway Company has increased its capital stock from $24,000 to $150,000, and its indebtedness from nothing to $100,000.

HARRISBURG, PA.—The Elizabethtown & Florin Street Railway Company has filed a notice of increase of capital stock from $30,000 to $220,000 with the Secretary of State.

HARRISBURG, PA.—The extension to the Capitol lighting plant has been completed and is now furnishing electricity for the 500 arc lamps in Capitol Park, the State Conservatory and museum building, which will result in the saving of $1,000 per month for the state. The above have been lighted from a private plant in the past.

MILLERSBURG, PA.—A telephone company has been organized to construct a telephone line from Millersburg to Frystown, Mt. Aetna and Myerstown. The directors are James F. Schlasman, D. S. Enminger, of Mt. Aetna; Morris Fisher, Riley Frantz, Harry Miller, A. A. Spannuth and Emmanuel Merkey.

SCRANTON, PA.—Plans have been completed by the American Railways Company, which controls the Scranton Railway Company, for the construction of a large power plant, to be located on the Lackawanna River, near the present power house. The cost of the plant is estimated at $500,000. Frank Caum is manager.

DEADWOOD, S. D.—It is reported that the Continental Copper Company is making arrangements to install complete electrical equipment to operate its mines.

DEADWOOD, S. D.—The Black Hills Traction Company has secured water rights on the Sand Creek, north of here, and will soon commence work on the construction of another large power plant. The output of the new power plant of the company at Belle Fourche, which generates 900 kilowatts, has all been contracted for, and contracts have also been taken for the greater part of the output of the new plant.

NASHVILLE, TENN.—The Nashville Railway & Light Company is planning to extend its lines to the National Cemetery on the Gallatin Turnpike, a distance of about five miles.

EL PASO, TEX.—Captain Thomas A. Davis, president of the El Paso Military Institute, has applied to the government for permission to run an electric railway through Fort Bliss from El Paso to the Military Institute.

OGDEN, UTAH.—The waters of the Willard Canyon, 16 miles from Ogden, are to be developed to generate electricity to operate the Ogden Northwestern Electric Railway and its extension to Brigham City. M. S. Browning, acting for his associates, has acquired all the available water rights in the canyon. It is now proposed to erect a large power house not far from the canyon, to extend the Hot Springs Railway, and to equip the entire system to be operated by electricity, and also to operate cars between Ogden and the terminal of the road. The cost of the plant is estimated at $40,000.

SALT LAKE CITY, UTAH.—H. V. Hart has purchased the property of the Century Gold Mining & Milling Company, and will enlarge the mill and build a large power plant on Raft River.

RICHFORD, VT.—The village of Sutton, Que., Can., has voted to accept the proposition of the Sweat-Comings Company, of this place, to furnish electricity for lighting. It is proposed to transmit electrical energy to the international boundary line, and from there it will be distributed by the village officials, who will also supply Abercorn with electricity for lamps. The new equipment for the plant of Sweat-Comings Company, consisting of new water wheels, steam engine, boilers and dynamo, has arrived and will be installed as soon as possible.

RUTLAND, VT.—The Rutland Street Railway, Lighting & Power Company and the Rutland City Electric Company have been consolidated under the name of the Rutland Street Railway, Lighting & Power Company. By the merger the company takes over all the rights, franchises, plant and equipment of the Rutland City Electric Company, for which it paid $300,000. The new company will operate the street railway and the lighting and power plant separately. The officers of the company are G. T. Rogers, of Binghamton, N. Y., president; Leo W. Wise, of New York, N. Y., vice-president, and Charles H. West, of Rutland, secretary and treasurer.

NORFOLK, VA.—Plans are being made by the Norfolk & Portsmouth Traction Company to erect a substation for its Portsmouth division, in connection with the $1,000,000 power plant just completed.

VIRGINIA BEACH, VA.—The question of installing an electric light plant in this place is under consideration. E. D. Ferebee is interested in the matter.

EDMONDS, WASH.—The Siegfriedt Syndicate has made application to the County Commissioners for a franchise for an electric railway through Edmonds toward Bitter Lake.

NORTH YAKIMA, WASH.—The Yakima Valley Transportation Company has applied to the County Commissioners for a franchise to construct and operate an electric railway along certain public roads in the county.

BARABOO, WIS.—Extensive improvements are contemplated by the Baraboo Telephone Company, which will involve an expenditure of about $5,000. It is proposed to replace the present wires with cables throughout the business district. About 18,000 ft. of cable will be required.

DODGEVILLE, WIS.—Owing to a disagreement between the City Council and the Dodgeville Electric Light Company, the Council has ordered the company to discontinue its service until an agreement is reached. The 10-year franchise of the company expired March 1, and the company has continued lighting the streets since that time, pending an agreement.

EAU CLAIRE, WIS.—The State Railroad Commission has issued an order authorizing the Chippewa Valley Railway, Light, Heat & Power Company to readjust its rates, which it is said means a slight reduction to consumers.

MARINETTE, WIS.—The owners of water power on the Menominee and Peshtigo rivers have combined and contemplate organizing a holding company to take over the rights and holdings of the same. Senator Isaac Stephenson, Perley Lowe, Francis A. Brown, A. F. Hancock, P. A. Martineau and Elmer Grimmer, of this city, and F. H. Johnson, of Oshkosh, Wis., are interested in the enterprise.

PORTAGE LA PRAIRIE, MAN., CAN.—Extensive improvements are contemplated by the Central Electric Company to its plant, which will involve an expenditure of between $25,000 and $40,000. A new building will be erected and other improvements made. John O'Brien is manager.

BRANTFORD, ONT., CAN.—The Grand Valley Railway will construct two new extensions to its system during the spring. One will be built from Brantford, to Port Dover, a distance of 35 miles, and the other from Brantford to Woodstock, 18 miles in length.

BRANTFORD, ONT., CAN.—The hydro-electric plant of the Western Counties Power Company at DeCew Falls was placed in operation March 16, and in future will supply electrical energy in connection with the local plant. The combined output of the two plants is between 50,000 and 60,000 horse-power. The company will supply electricity for industrial purposes at $19.50 per horse-power per year. The company claims that its rates which, under agreement must continue for 25 years, are much lower than can be offered by the Hydro-Electric Commission.

HAMILTON, ONT., CAN.—In the decision handed down by Judge Snider in the street lighting arbitration matter the cost of street lamps will be reduced from $85 to $70 per lamp per year, the reduction to date back to October, 1905, which means a refund of $32,000 to the city from the company. The reduction continues during the balance of the contract, which will expire in July, 1909. It is expected that the company will appeal against the decision.

PRESTON, ONT., CAN.—The Town Council has decided to apply to the Hydro-Electric Power Commission for 600 horse-power of energy. The municipal electric plant will use 200 horse-power, and the other 400 horse-power will be for sale. As soon as the town receives electricity from the Niagara plant an all-night service will be given both for street and residential lighting service.

SHERBROOKE, QUE., CAN.—The Sherbrooke Power, Light & Heat Company contemplates installing another 500-kw, three-phase, 60-cycle generator, to be installed by October next. A. Sangster is superintendent.

New Industrial Companies.

THE U. S. ELECTRICAL MANUFACTURING COMPANY, of Los Angeles, Cal., has been incorporated, with a capital stock of $200,000, by Timothy Mahoney, J. R. Amesty, W. J. Sherriff, G. Russo and Edgar Sharp.

THE ELECTRIC TIMBER CUTTER COMPANY, of San Francisco, Cal., has been incorporated, with a capital stock of $200,000, by M. L. Degnen, M. H. Newman and A. W. Hepburn. W. E. Cashman is attorney.

THE PETTEY ELECTRICAL SIGNAL COMPANY, of Alexandria, Va., has been incorporated with a capital stock of $10,000. The officers are: F. M Hill, president; Zoro Hill, secretary, and G. W. Pettey, manager.

THE AUTOMATIC SWITCH COMPANY, of Mobile, Ala., has been chartered with a capital stock of $10,000. The company proposes to manufacture and sell mechanical and electrical machinery and appliances.

THE C. H. D. BABB & COMPANY, of Bangor, Me., has been incorporated, with a capital stock of $25,000, for the purpose of manufacturing plumbing, heating and lighting apparatus. C. H. Babb is president and R. H. Downing treasurer, both of Bangor.

THE KOZESNIK ELECTRIC THIRD-RAIL SAFETY SYSTEM COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $100,000, by Bernard Hartman, Arthur Hartman and Charles Kozesnik, all of New York, N. Y.

THE OCALA PLUMBING & ELECTRICAL COMPANY, of Ocala, Fla., has filed articles of incorporation, with a capital stock of $5,000. The officers of the company are: David S. Woodrow, president, and George H. Ford, secretary and treasurer.

THE NAGEL MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $15,000, by Theodore Nagel, E. C. Frank Meier and Walter Snyder. The company proposes to manufacture electrical and mechanical specialties.

THE BLACKMAN TALKING MACHINE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $30,000. The directors are: A. L. Blackman, of East Orange, N. J., and George G. Blackman, of New York, N. Y.

THE H. B. DOHERTY COMPANY, of Binghamton, N. Y., has been incorporated, with a capital of $5,000, by Harry B. Doherty, Welcome B. Johnson, Benjamin H. Harris, of Binghamton, N. Y. The company proposes to manufacture motors, engines, carriages, boats, etc.

THE ALMSTEAD MANUFACTURING COMPANY, of Rochester, N. Y., has filed articles of incorporation, with a capital stock of $30,000. The company proposes to manufacture electrical supplies. The directors are Raymond P. Almstead, Morris J. Almstead and John A. Almstead.

THE KLERVIN COMPANY, of Auburn, N. Y., has been incorporated, with a capital stock of $50,000, for the purpose of manufacturing smoke preventives. The directors of the company are Frank H. Messinger, Charles W. Storke, of Auburn, and Ray S. Messinger, of Geneva, N. Y.

THE E. W. STEVENS COMPANY, of Somerville, N. J., has been incorporated, with a capital stock of $200,000, to manufacture engines, vehicles, etc. The incorporators are: F. Knowlton, of New York, N. Y.; E. D. Cronin, of Brooklyn, N. Y., and R. H. Osgoodby, of Somerville, N. J.

THE ROYAL ELECTRIC COMPANY, of Milford, Ind., has filed articles of incorporation, capitalized at $20,000. The company proposes to establish a plant for the manufacture of electrical and mechanical machinery and appliances. Levi N. Nehr, Asa Le Roy Miller and J. B. Neff are the directors.

THE BALTIMORE LIGHT & EQUIPMENT COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $100,000, for the purpose of manufacturing lighting appliances and fixtures. The incorporators are: G. E. Stickney, Rutherford, N. J.; W. I. Willis, and M. Frank, of Brooklyn, N. Y.

THE INTERNATIONAL PROCESS COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $25,000, for the purpose of carrying on a mechanical, electrical and civil engineering business. The incorporators are: Ernest W. Marshall, George H. Marshall, Henry C. Duter, all of New York, N. Y.

THE MANHATTAN HIGH POWER CAR COMPANY, of Manhattan, New York, N. Y., has been incorporated for the purpose of manufacturing motor cars. The capital stock of the company is placed at $300,000 and the incorporators are: F. W. Barker, J. F. Brandenburg, and F. C. Bonny, New York, N. Y.

THE HOOSIER STORAGE BATTERY COMPANY, of Evansville, Ind., has incorporated to establish a plant for the manufacture of storage batteries and all kinds of electrical and mechanical devices and appliances, and also a plant to furnish motive power to carry on said business. John C. Zutt, W. M. Copeland, A. F. Karges and Ezra Lyon are the directors.

THE UNITED CARBON TRUST COMPANY, of Adams, Mass., has been organized with a capital stock of $5,000,000 and the following officers: Trustees, George N. Hopkins, of Pittsfield; Charles Howes, of Adams, and E. H. Beers, of North Adams; S. H. Fairfield, of North Adams, treasurer. At present the company has a small plant and manufactures carbon brushes, lightning arresters, arc lamps, and moving-picture carbon pencils. The company is planning to secure larger quarters in North Adams and Pittsfield, and will extend its business.

Company Elections.

POMONA, CAL.—At the annual meeting of the Pomona Valley Telephone Company the following-named officers were elected: F. W. Thomas, president; Arthur M. Dole, secretary; C. E. Walker, treasurer, and D. S. Parker, manager.

SAN BERNARDINO, CAL.—At the annual meeting of the San Bernardino Valley Traction Company the following named officers were elected: Howard E. Hunting, president; Mr. Ward, vice-president; Mr. Cook, secretary and treasurer, and A. C. Denman, general manager.

ELIZABETH, IND.—At the annual meeting of the Harrison County Telephone Company the following-named officers were elected: Philip J. Blunk, president; E. L. Smith, secretary; Charles J. Treece, treasurer, and Thomas Evans, superintndnt.

MECHANICSBURG, IND.—At the annual meeting of the Reese Mill Telephone Company the following-named officers were elected: James Pittenger, president; W. H. Wilson, secretary, and George Reagan, treasurer.

PLYMOUTH, IND.—At the annual meeting of the Winona Telephone Company the officers were elected as follows: Samuel Tomilson, president; A. B. Diggs, vice-president, and W. S. Daniels, secretary and treasurer.

STENDAL, IND.—At the annual meeting of the Stendal Home Telephone Company the following named officers were elected: Abner McAllister, president; Spencer Barrett, vice-president, and Louis F. Siebe, manager.

WARREN, IND.—At the annual meeting of the Warren Telephone Company the following named officers were elected: John S. Prowl, president; George S. Good, vice-president; J. L. Priddy, secretary and treasurer, and Frank Canaday, manager. About $2,000 has been spent for improving the system, and further improvements will be made during the coming year. The lines will be extended and new ones built.

SPRINGDALE, IA.—At the annual meeting of the West Liberty & Springdale Telephone Company the following-named officers were elected: William Wilkins, president; W. D. Ridenour, vice-president; F. H. Battey, secretary and treasurer, and J. Hinkhouse, trustee. The company has decided to double the entire line.

MARTINSBURG, IA.—At the annual election of the Martinsburg Mutual Telephone Company the following-named officers were elected: Fred Thornburg, president; R. H. Shultz, vice-president; W. G. Lister, secretary, and Earl Ogden, treasurer.

RICHMOND, MASS.—At the annual meeting of the Richmond Co-operative Telephone Company held recently the name of the company was changed to the Richmond Telephone Company and the officers re-elected as follows: Frederick A. Clement, president and general manager; Sidney M. Loveland, vice-president, and John R. Ayer, clerk and treasurer.

GRAWN, MICH.—At the annual meeting of the Grawn Rural Telephone Company the following-named officers were elected: M. A. Brest, president; W. E. Batey, secretary, and F. Van Horn, manager.

CRETE, NEB.—At the annual meeting of the Crete Telephone Company the following-named officers were elected: C. W. Nunemaker, of Tobias, president; B. G. Miller, of Crete, vice-president and manager, and C. E. Bowlby, secretary and treasurer.

BERGEN, N. Y.—At the annual meeting of the Bergen Telephone Company the following-named officers were elected: George R. Fuller, president; George Sands, vice-president; C. M. Beattie, secretary, and C. E. Housel, treasurer.

UTICA, N. Y.—At the annual meeting of the Bossert Electric Construction Company the following directors were elected: D. N. Crouse, B. M. Crouse, F. K. Kernan, W. N. Kernan, Henry Quinn, C. B. Rogers and F. G. Scofield. The present officers were re-elected for the ensuing year.

GALION, OHIO.—At the annual meeting of the Galion Telephone Company the following-named officers were elected: Mark Cook, president; A. A. Whitney, vice-president; S. M. Wolf, secretary; J. W. Cupp, treasurer, and C. R. Callaghan, general manager.

HURON, OHIO.—The Mutual Telephone Company has been organized and the following-named officers elected: Dr. N. E. Woessner, president; Henry Spranker, vice-president, and T. M. Sprowl, treasurer. Work will commence on the construction of the line as soon as the weather will permit.

OKOLONA, OHIO.—At the annual meeting of the Okolona Mutual Telephone Company the following named officers were elected: Fred Gunn, D. Panning, vice-president; J. A. Benien, secretary, and G. H. Freytang, treasurer.

SALEM, S. D.—The West Vermillion Telephone Company has elected the following-named officers: N. E. Carpenter, president; Philip Roche, secretary, and Charles Padgett, treasurer. The company expects to have its line completed and connected with Salem soon.

CHATTANOOGA, TENN.—At the annual meeting of the Chattanooga Railways Company the following named officers were elected: John Graham, president; C. P. King, vice-president; W. H. Lawton, secretary and treasurer.

BOWLING GREEN, VA.—At the annual meeting of the Carolina Telephone Company the following-named officers were elected: C. T. Smith, president; W. E. Ennis, vice-president; Athol Collins, secretary, and L. E. Martin, treasurer. The company is planning to extend its lines at once to various towns in the county.

SPOKANE, WASH.—At the annual meeting of the Washington Water Power Company the following were elected trustees: W. A. White, of New York, N. Y.; H. M. Richards, James M. Glover, L. M. Davenport, A. B. Campbell, J. P. M. Richards, E. F. C. Van Dissell, D. L. Huntington and J. D. Sherwood, of Spokane; H. Parsons and Frank Lyman, of New York, N. Y.

HAGER CITY, WIS.—At the annual meeting of the Hager City Telephone Company the following-named officers were elected: A. F. Andersen, president; J. W. Milton, secretary, and J. H. Gilmore, treasurer.

DAYTON, WYO.—At the annual meeting of the Tongue River Telephone Company the following named officers were elected: R. E. Mills, president; J. Dickson, secretary, and J. O. Kier, treasurer.

HONOLULU, H. I.—At the annual meeting of the stockholders of the Kauai Electric Company, Ltd., the following officers were elected: D. P. R. Isenberg, president; F. M. Swanzy, vice-president; E. H. Wodehouse, treasurer; T. C. Davies, secretary; H. W. M. Mist, auditor.

HONOLULU, H. I.—At the annual meeting of the stockholders of the Hawaiian Electric Company, Ltd., the following officers were elected: J. A. McCandless, president; F. W. Macfarlane, vice-president; F. C. Atherton, treasurer; Godfrey Brown, auditor; W. L. Hopper, secretary.

New Incorporations.

CLARKSVILLE, ARK.—The Johnson County Telephone Company has been granted a charter by the Secretary of State. The company is capitalized at $6,000 and the officers are: W. H. Hunt, president; R. S. Davis, vice-president; J. S. Kolb, secretary, and V. E. Davis, treasurer.

COTTON PLANT, ARK.—The Cotton Plant Light & Power Company has filed articles of incorporation, with a capital stock of $10,000. The incorporators are F. H. Kennedy, D. H. Echols, E. P. Ford and others.

MULBERRY, ARK.—The Mulberry Ice & Light Company has been organized, with a capital stock of $10,000, and proposes to erect a light plant and ice factory.

OAKLAND, CAL.—The San Francisco, Oakland & San José Consolidated Railway Company has been organized for the purpose of consolidating the San Francisco, Oakland & San José Railway and the San Francisco & Bay Counties Railway, which was recently incorporated for the purpose of constructing an electric railway from San Francisco to San José. The present plan of the company is to continue the operation of the three lines operated at present by the San Francisco, Oakland & San José Railway, to construct a railway to San José, to build a branch road to Northbrae and another branch to Claremont, and also to connect the mainland with Yerba Island by means of a tunnel. The company is capitalized at $7,750,000 and the directors are F. M. Smith, F. C. Havens, E. A. Heron, Heron H. Wadsworth and Dennis Searles.

LOS ANGELES, CAL.—Articles of incorporation have been filed for the Los Angeles & San Francisco Short Line Railway Company by Captain John Cross, A. P. Cross, Walter F. Haas, M. K. Miller, Charles Wier, M. H. French, W. R. Ireland, C. S. Biernell and J. F. Loomis. The company is capitalized at $2,000,000.

SAN LEANDRO, CAL.—Articles of incorporation have been filed for the Suburban Light & Power Company. The company is capitalized at $1,000,000 and the directors are Charles A. Jeffrey, of Oakland; R. W. Geisenhofer, L. B. Smith, William Lucas, A. J. Lloyd, of San Leandro; Jacob Harner, Jr., and J. W. Burge, of Hayward. The company proposes to furnish light, heat and power to suburban towns on the east side of the bay.

SMYRNA, DEL.—The National Construction Company has been incorporated to build an electric railway from Delaware City to Lewes. J. W. Endean is chief engineer and general manager of the company.

CHICAGO, ILL.—Articles of incorporation have been filed for the Rockford Light & Fuel Company. The capital stock of the company is placed at $2,500, and the incorporators are: John A. Johnson, Anton E. Carlson and William Johnson.

CHICAGO, ILL.—The Calumet & South Chicago Railway Company has filed articles of incorporation, with a capital stock of $1,000. L. A. Busby, H. P. Weber and E. B. Hamilton.

McCALL, ILL.—The McCall Farmers' Telephone Company has been incorporated, with a capital stock of $2,490, by Emile Coeur, Archibald C. Williams and C. M. Benner.

PANA, ILL.—Articles of incorporation have been filed for the Pana, Girard & Jacksonville Railroad Company. The company is capitalized at $50,000, and the incorporators are: B. F. Darnielle, J. N. Anderson, W. F. Bercher, of Springfield; John J. Stowe, of Girard, and Charles E. Sargent, of Greenfield. The principal office of the company is located at Springfield.

JEFFERSON, IA.—The Jefferson Interurban Railway Company has been chartered, with a capital stock of $10,000, to build an interurban railway from Jefferson to Des Moines and to Perry. The officers of the company are: Albert Head, president; Henry Haag, vice-president, and Mahlon Head, treasurer.

TOPEKA, KAN.—The Marlam Construction Company has been chartered, with a capital stock of $250,000, for the purpose of constructing the interurban railway of the Kansas City & Kansas Southwestern Railroad Company from Kansas City to Lawrence, with a branch to Topeka and another to Independence. E. M. Lambkin, of Kansas City, is interested in the enterprise.

FRANKFORT, KY.—The Cairo & Norfolk Railway Company has filed articles of incorporation, with a capital stock of $500,000. The incorporators are: L. W. Goode and E. E. Weston, of New York, N. Y.; M. W. Kelly, of Madison, Wis.; W. A. Usher, R. E. Lockridge, B. A. Neal, F. R. Allen and others.

PORTLAND, ME.—The Consolidated Power & Light Company, of South Dakota, has been incorporated, with a capital stock of $3,000,000. The purpose of the company is to install and operate power plants. G. A. Hutchins is president and C. H. Tolman clerk, of Portland, Me.

PORTLAND, ME.—The Crawfordsville Water & Gas Company has been incorporated, with a capital stock of $375,000. The company proposes to furnish gas and electricity. The officers are: H. L. Cram, president, and B. L. Steward, of Portland, treasurer.

WATERVILLE, ME.—The Kennebec Farm & City Telephone Company has been incorporated, with a capital stock of $10,000, and is practically an extension of the Somerset Farmers' Telephone Company. F. E. Webster is president of the company and Frank L. Ames treasurer and general manager.

ANNAPOLIS, MD.—A bill has been introduced to the State Legislature incorporating the Washington, Patuxtent & Drum Point Railroad Company. The incorporators are: C. A. M. Wells, Joseph R. Owens, Rexford M. Smith, Wallace A. Bartlett and Charles A. Wells, of Prince George's County; Ira J. Baker and Charles C. Mayer, of Washington. The company is capitalized at $250,000, and it proposes to construct a railroad to be operated by steam or electricity from a point on the Chesapeake Beach Railroad in Calvert or Anne Arundel counties, east of the Patuxtent River, to Drum Point and Solomon's Island.

BALTIMORE, MD.—Articles of incorporation have been filed for the Lee Electric Company, with a capital stock of $50,000, by Arthur L. Bosley, Robert L. Gill, both of Baltimore, and Joseph F. Turner, of Philadelphia, Pa.

BLOOMINGDALE, MICH.—The Bloomingdale Telephone Company has been organized with the following officers: Charles Linton, president; Jesse Cone, secretary, and E. J. Marrifield, treasurer. The company will assume control of all the lines owned by the Linton Baker Company.

FERRIS, MICH.—The farmers of East Ferris have organized the East Ferris Telephone Association. The officers are: George Wilson, president; Charles W. Sherman, vice-president, and V. Johnson, secretary.

LANSING, MICH.—Articles of incorporation have been filed with the Secretary of State for the North Burns Telephone Company, with a capital stock of $10,000.

NEW TROY, MICH.—Articles of incorporation have been filed for the New Troy Telephone Company with a capital stock of $10,000.

NEW TROY, MICH.—The Citizens' Telephone Company, of Berrien County, has been organized, with a capital stock of $10,000, by F. H. Morley, William C. Bowers, William A. Keith, Louis N. Tatro and George Ashman.

BAGLEY, MINN.—The Bagley-Omega Telephone Company has filed articles of incorporation, with a capital stock of $25,000. The incorporators are E. J. Warren, M. J. Kolb and S. M. Bugge.

ELM CREEK, MINN.—Articles of incorporation have been filed for the Elm Creek Telephone Company, with a capital stock of $2,000, by J. D. Schafer, W. O. Pruitt, J. L. Ridgway, William Grill and A. P. Freitag.

PIPESTONE, MINN.—The Pipestone County Rural Telephone Company has been organized for the purpose of constructing a telephone line to connect with the Northwestern Telephone Company. The officers of the company are: E. S. Butman, president; J. H. Crawford, vice-president; G. S. Sindt, secretary, and Louis Lettow, treasurer.

RICHVILLE, MINN.—The Richville Telephone Company has been chartered, with a capital stock of $5,000, by James Shaw, T. K. Johnson, C. A. Jimner, C. A. Fribery, Jr., J. O. Robb and Frederick Prentice.

CHILLICOTHE, MO.—The Livingston County Mutual Telephone Company has been organized, with a capital stock of $15,000, for the purpose of operating a mutual telephone system in this city and in Livingston County.

BOZEMAN, MONT.—Articles of incorporation have been filed for the Gallatin Valley Electric Railway Company for the purpose of constructing an electric railway, 30 miles in length, through the Gallatin Valley. The company is capitalized at $100,000, and the incorporators are: W. H. Winfree, W. S. Hartman, C. S. Hartman, H. A. Bolinger and H. M. Stewart.

BRISTOW, NEB.—The Boyd County Mutual Telephone Company has been organized at this place for the purpose of installing a telephone system from river to river. An exchange will be established in Bristow and the lines extended to the rural districts.

RENO, NEV.—The Eastern Nevada Power Company has filed articles of incorporation with the county clerk. The company is composed of Utah capitalists, who propose to establish a large reservoir and power plant for irrigation and power purposes in Lincoln County. The capital stock of the company is placed at $500,000. Water will be taken from the Colorado River.

JERSEY CITY, N. J.—The Interstate Traction Company has been incorporated, with a capital stock of $200,000, by G. R. Warner, B. S. Mantz and A. C. Baer, of Jersey City.

JERSEY CITY, N. J.—Articles of incorporation have been filed for the United Railway, with a capital stock of $200,000, by H. O. Coughlan, L. H. Gunther and John R. Turner.

BUFFALO, N. Y.—Articles of incorporation have been filed for the Lima-Honeoye Electric Light & Railroad Company, with a capital stock of $50,000. The directors are: Charlotte E. Georger, Eugene A. Georger, of Buffalo, and Edwin D. Watkins, of Lima. This is a organization of the company after sale.

OX BOW, N. Y.—The Ox Bow Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock of the company is placed at $550, and the directors are D. M. Mills, A. B. Clark and W. G. Lanito, all of Ox Bow.

WARSAW, N. Y.—The Wyoming County Home Telephone Company has filed articles of incorporation, with a capital stock of $50,000. The incorporators are: Howard Hendrickson, William Hendrickson and George H. Rymers, of Albany, N. Y.

HIGH POINT, N. C.—A charter has been granted to the North State Telephone Company, with a capital stock of $50,000, of which $20,000 has been subscribed. The incorporators are W. H. Ragan, V. A. J. Idol, E. M. Armfield, Charles Houser, J. F. Hayden and E. D. Steele.

GRAFTON, N. D.—The Herreatt Telephone Company has been organized to build a telephone line out 10 miles from Grafton to connect with the central office at this place. F. E. Linhart is president of the company and A. C. Jorandberg, secretary.

AMELIA, OHIO.—The Amelia Independent Telephone Company has been incorporated with a capital stock of $10,000, by D. C. Warner, Bennett Behymer, W. C. Coombs, A. A. Eppert and A. N. Coombs.

AVON, OHIO.—The Avon-Sheffield Telephone Company has been incorporated, with a capital stock of $10,000, by J. R. Piper, H. B. Martindale, Andrew Conrad and John Biesneher.

BETHEL, OHIO.—The Bethel Home Telephone Company has been incorporated, with a capital stock of $10,000, by George P. Hibbetz, M. W. Fagaly, T. A. Pinkham, O. B. Davison, P. E. Wilson and O. C. Warner.

GRAFTON, OHIO.—The Grafton Mutual Telephone Company has been incorporated with a capital stock of $10,000 by E. C. Storrs and others.

GUERNSEY, OHIO.—The Sarchet Run Telephone Company was organized at Mantua and the following officers elected: W. L. Simpson, president; Henry Hamilton, vice-president; M. K. Wells, secretary, and John McCullough, treasurer.

NORTH EATON, OHIO.—The North Eaton Telephone Company has been incorporated, with a capital stock of $10,000. The incorporators are Charles W. Langdon, I. N. Haven, Thomas Hales, Aklen Nichols, John Cawley, L. T. Davis and others.

FORT JENNINGS, OHIO.—The Fort Jennings Farmers' Mutual Telephone Company has been formed by Peter Roose, R. J. Cummings, Shelby Harris, Charles Miricle and others.

NEW BAVARIA, OHIO.—The New Bavaria Farmers' Mutual Telephone Company has been chartered by C. E. Young and others.

DUKE, OKLA.—The Duke Telephone Company has been chartered, with a capital stock of $500, by J. L. Williams, W. S. Poole, W. O. Ames and C. Phelps, all of Duke.

BINGER, OKLA.—The Jewell Telephone Company has filed articles of incorporation with a capital stock of $3,000. The incorporators are W. K. Mitchell, N. Godfrey and N. Meadows, all of Binger.

NOBLE, OKLA.—The Farmers' Union Spring Creek Telephone Company has been incorporated, with a capital stock of $15,000, by A. Windrow, E. W. Richardson, Z. Relick and H. B. Richardson, all of Noble.

WOODWARD, OKLA.—Articles of incorporation have been filed for the Farmers' Hub Telephone Company, with a capital stock of $3,000, by Henry Hugerman, L. A. Steat, J. E. Combs and F. S. Beher, all of Woodward.

MAURERTOWN, PA.—A charter has been granted to the Maurertown Mutual Telephone Company, with a capital stock of $5,000. The officers of the company are: C. F. Hockman, president; J. E. Boyer, vice-president; H. C. Rosenger, secretary and treasurer.

WILMORE, PA.—The Wilmore Rural Telephone Company has been organized, with a capital stock of $5,000, for the purpose of building telephone lines into the surrounding country. The officers of the company are: Wallace Sherbine, president, and S. W. Crum, secretary.

JEFFERSON CITY, TENN.—The Citizens' Telephone Company has been incorporated, with a capital stock of $10,000, by B. M. Tittsworth, J. C. Thomas, J. V. Cline, I. M. Tittsworth, I. M. Cate, G. A. Moody and R. M. Bales.

NASHVILLE, TENN.—The Consolidated Electric Company has been incorporated, with a capital stock of $15,000, by George A. Wood, A. G. Rutherford, James A. Singleton and others.

NASHVILLE, TENN.—The Chucky Valley & Cherokee Telephone Company, of Washington County, has been incorporated, with a capital stock of $5,000, by H. C. Jackson, J. J. Brown, E. S. Brown, J. W. Deaderick and John Graham.

McDADE, TEX.—The Knobbs Telephone Company has been organized for the purpose of installing a telephone system to connect McDade with the surrounding towns.

COLFAX, WASH.—The Penawawa Telephone Company, Ltd., has been organized for the purpose of erecting an extensive system of rural telephone lines in Colfax wheat belt. The officers of the company are: Silas Smith, president, and Herbert Smith, secretary and treasurer.

EDMONDS, WASH.—Articles of incorporation have been filed for the Edmonds Independent Telephone Company, with a capital stock of $2,500, by A. M. Yost, James Mowat, Zophar Howell and T. A. Siegfrendt.

SEATTLE, WASH.—The N. & S. Electric Company, of Seattle, has been incorporated, with a capital stock of $24,000, by Robt. Wilhelm and Wilson Niedergesalss.

SEATTLE, WASH.—The Klickitat Power & Electric Company has been incorporated, with a capital stock of $25,000, by S. Hill, W. G. Collins and N. B. Brooks.

CUSHING, WIS.—The Equity Telephone Company has been organized for the purpose of building a telephone line from Luck to Cushing. The officers of the company are: J. P. Peterson, president; G. E. Johnson, vice-president; E. Wilson, secretary, and Benamin Jergerson, treasurer.

MOSINEE, WIS.—The Mosinee Telephone Company has filed articles of incorporation, with a capital stock of $1,500. The incorporators are Howard Dessert, Arden Paronto, W. von Berg, J. P. Kauter and W. F. La Du.

OSCEOLA, WIS.—Articles of incorporation have been filed for the Osceola Electric Company. The capital stock of the company is placed at $4,000 and the incorporators are T. C. Ladd, C. W. Bloom and William Hillskatter.

RUBICORN, WIS.—The Hartford & Saylesville Telephone Company has been incorporated with a capital stock of $1,200, by A. H. Lambrecht, John Sullivan, Henry Lepien and others.

RUDOLPH, WIS.—Articles of incorporation have been filed with the Secretary of State for the Rudolph Telephone Company by C. O. Hasel, John Granger and Frank Whittman. The company is capitalized at $2,500.

TWO RIVERS, WIS.—The Range Line Telephone Company has been organized and the following officers elected: Peter Becker, president; Anton Hammernik, secretary, and R. Bucholz, treasurer. Work on the construction of the line will begin at once.

VIROQUA, WIS.—Articles of incorporation have been filed with the Secretary of State for the Crawford-Vernon Mutual Telephone Company. The following-named officers have been elected: P. N. Peterson, president; C. Stevlington, vice-president; K. M. Hooverson, secretary, and A. E. C. Christenson, treasurer.

COBALT, ONT., CAN.—The Cobalt Light, Power & Water Company has been incorporated here, with a capital of $10,000. The incorporators are: J. R. Gordon, of Sudbury, Ont.; C. C. V. Campbell, C. A. Gilmour, of Cobalt, Ont.

LONDON, ONT.—The London Township Telephone Company has been incorporated, with a capital stock of $5,000.

MORRISBURG, ONT.—The Morrisburg Electric Railway Company has applied to the Ontario Legislature for permission to incorporate. The company proposes to construct a system of electric railways from Morrisburg, through Williamsburgh, and thence through Russell to Winchester.

MOUNT FOREST, ONT., CAN.—The Mt. Forest, Wingham & Grey Telephone Company is being organized to operate telephone lines in Mt. Forest and surrounding towns.

Legal.

RECEIVER FOR LIGHT PLANT.—Charles G. Henry has been appointed receiver of the Pond-Decker Manufacturing Company, of Newport, Ky., which owns the electric light plant and the property upon which the Newport Stave Company is operating its plant. The application for a receiver was made by the American National Bank, of Fort Smith.

DUTY OF ELECTRIC COMPANIES TOWARD TRESPASSERS.—In Guinn vs. Delaware & Atlantic Telegraph & Telephone Company, New Jersey, 62 Atl., 412, it was held that a telephone company was liable where a person was injured by coming in contact with one of its wires while he was crossing private property without permission. The guy wire, which caused the injury, was maintained in such a position that it was likely to become crossed with an electric light wire. The theory upon which a recovery was allowed was that, if the injured party was a trespasser at the time of the accident, his wrong was one against the land owner and not a public wrong or one against the public or defendant telephone company.

FORECLOSURE OF PINE BLUFF WATER AND LIGHT PLANT.—Judge Jacob Trieber, of the Federal Court, has appointed C. Philip Waters, of Little Rock, and Frank G. Bridges, of Pine Bluff, receivers of the Pine Bluff Light & Water Company, of Pine Bluff, Ark., which is the result of a suit filed in the United States Circuit Court by the New York Trust Company and Osborn W. Bright to foreclose a mortgage of $250,000 held by the New York company on the property rights and franchises of the company. A contest has been on in Pine Bluff for years between the city and the water company, the city endeavoring to get control of the water works. As the plant is to be sold, it is expected that the city will purchase it.

CONTRACT NOT EXTENDED BY LENGTHENED SERVICE.—Judge John M. Kennedy on March 21 handed down an opinion in the case of the Allegheny County Light Company against the Wabash-Pittsburg Terminal Railroad Company, in which he refuses to sustain the contention of the plaintiff company that the holding or continuation of a light service was an extension of a contract. The light company entered a suit to recover $2,607.28, with interest. The railroad company, in an affidavit of defence, claimed that it was only liable for the amount of the light used, as its contract had expired, while the plaintiff company was charging for a period when no light was used, on the ground that the defendant renewed its contract by holding over. The light company asked for judgment for want of a sufficient affidavit of defence, which Judge Kennedy in his opinion refuses, stating that the railroad company was only bound to pay for the light used and could not be held for a year's service, as the light company contended.

ACTION AGAINST ELECTRIC COMPANY BY EMPLOYEE INJURED WHILE ENGAGED IN CONSTRUCTING MANHOLE.—Whether an electric light company is guilty of negligence in having a manhole lowered into a place made for it without having it braced, with the result that an employee, shoveling sand from beneath it to allow of its being still further lowered, was injured by its breaking and one of the sections falling on him, is a question for the jury to decide, and on such a statement of facts the court should not nonsuit the plaintiff without submitting the question to the jury. Upon the question of the defendant's negligence, evidence on the part of the plaintiff was received which tended to show that it was not safe or proper to lower this structure without its being first braced interiorly and exteriorly. This precaution had not been observed by the defendant, and it therefore became a question of fact for the jury's determination whether the defendant had discharged the duty of ordinary care for the safety of its employees. Ward vs. Edison Electric Illumination Co., of Brooklyn, New York Supreme Court, Appellate Division, 108 N. Y. Supp., 608.

DAMAGES ALLOWED AGAINST ELECTRIC COMPANY FOR INJURIES RESULTING FROM UNINSULATED WIRE.—The plaintiff in a recent case against an electric light company was injured while at work constructing a wall near which one of the company's wires was strung. On the day of the injury the plaintiff was directed by a mason to move certain mortar from a mortar board at one end of the scaffold on which he was standing to a mortar board at the other end of the scaffold. It was raining, and the scaffold, board and tools were wet. In performing this work the plaintiff stepped upon the mortar board and slipped. Apparently he involuntary threw out his hands to save himself or restore his equilibrium, when his left forearm came in contact with the the heavily charged wire. He became at once insensible and fell to the ground upon a pile of rock. The court ruled that, so far as the injuries received by plaintiff from coming in contact with the wire directly are concerned, it is a fair inference from the evidence that the negligence of the defendant was the proximate cause thereof. Birsch vs. Citizens' Electric Co., Supreme Court of Montana, 93 Pac. Rep., 940.

GRANT OF TELEPHONE FRANCHISE BY MUNICIPAL CORPORATION.—A city ordinance extending to a telephone company the right to use the streets, alleys and public grounds of the city in the construction, operation and maintenance of its plant or system, and which does not, in any of its provisions, indicate an attempt to exclude other like corporations or companies from a like privilege, is not the grant of an exclusive right or privilege, and, when a city, by the granting of a such a privilege, has caused the recipient telephone company to incur expense in good faith and in reliance upon it, the city authorities, if the use be a public one, cannot arbitrarily impose by subsequent regulations, without necessity or the demands of public convenience, additional burdens upon the company which are clearly beyond the reasonable exercise of the police power. That a city council may make reasonable regulations relating to the maintenance and repair of defendant's plant is not open to argument; but such regulation is not to be exercised at mere whim and caprice. It must be proportionate to and commensurate with the public necessity for the protection and promotion of the public health, safety, necessity or convenience. The application of the police power cannot be extended by the authority which is intrusted with such application to an arbitrary misuse of private rights. City of Plattsmouth vs. Nebraska Telephone Co., Supreme Court of Nebraska, 114 N. W. Rep., 588.

LIABILITY TO LINEMAN INJURED ON FALLING POLE.—It is held that a telephone company is not liable in damages to a lineman for injuries received through the falling of a pole on which he was working while removing wires preparatory to taking the pole down. It appeared that the pole had rotted at the point where it entered the ground and that the fact was easily discovered by the application of tests known to the lineman had he made proper use of his knowledge. The liability of the company was based on the fact that the foreman had directed the lineman to ascend the pole and cut the wires and that he was negligent in so doing without having first tested the strength of the pole. On the question of the company's negligence, the court said that where a foreman directs an experienced lineman to climb a pole and cut wires, it would be unnecessary to tell him that the appearance of the pole above the ground does not indicate its safety, as the weak point is just below the surface of the ground, and whether the pole is defective there or not can only be ascertained by the usual test, and to inform him of the manner of making the test. Those matters are as much within the knowledge of the lineman as of the foreman, and, as between the lineman who knows all the facts and the foreman, the making of the test, the climbing of the pole and the various acts are details of the work. La Duke vs. Hudson River Telephone Co., New York Supreme Court, Appellate Division, 108 N. Y. Supp., 189.

Personal.

MR. L. L. JOHNSTON, of the Westinghouse Machine Company, delivered a lecture before the Modern Science Club, of Brooklyn, N. Y., on March 31, entitled "Gas Engines."

PROF. FRANK L. TUFTS, of Columbia University, will deliver a series of five lectures at the Hebrew Technical Institute, New York, on the subject of electricity and radioactivity.

PROF. CECIL B. SMITH, of Toronto, Can., delivered the principal address at the twelfth anniversary of the granting of the charter of the Clarkson School of Technology, which was celebrated March 14.

MR. G. MARCONI has been elected manager of the Marconi Wireless Telegraph Company, of London, England, to succeed Mr. H. Cuthbert Hall, who has resigned. Mr. Marconi has assumed his new duties, which may interfere with his projected early trip to this country.

MR. T. J. WEBER has resigned as general superintendent of the Pontiac Light Company, of Grand Rapids, Mich., to become engineer of the properties of Child, Hulswit & Co., bankers, of Grand Rapids. The properties include public utilities in Chattanooga, Tenn.; Laporte, Ind.; Matoon, Ill.; Cadillac and Cheboygan, Mich.; Fort Dodge and Muscatine, Iowa.

NEW YORK ELECTRICAL SOCIETY.—At the last meeting of the New York Electrical Society the following named gentlemen were elected to membership: Clark Potter Read, Jas. W. Owens, J. Allan Worth, Dr. Albert C. Geyser, Joseph W. Lowell, Clarence T. Coley, Bernard Elias, James J. Burnes, Albert C. Triaca, John C. Lotz, Edwin N. Lightfoot, William Leo Culley, Ray M. Telford and A. Schwennesen, of New York City, and Burtis D. Mack, of Jamaica, L. I.

GENERAL A. B. R. SPRAGUE, president of the Worcester Electric Light Company, has returned from a six weeks' trip through the West, in which he visited Colorado, New Mexico, Arizona, California, Oregon and other sections of the trans-Mississippi country. The trip was the first one of such length that General Sprague has had time to take for many years, and the development of the West since his last visit proved of deep interest. He was a guest of the General Electric Company at the annual dinner of the Boston office on March 27.

Obituary.

MR. WALTER L. TYLER, a member of the A. B. See Electric Elevator Company, died at his home in Brooklyn, N. Y., March 22. He was 41 years of age, and was graduated from Columbia in the class of 1887. Mr. Tyler was a member of the Crescent Athletic Club, the Psi Upsilon Fraternity, the Hardware Club and the Hamilton Club, of Brooklyn. He was also a director of the Flatbush Trust Company, and vice-president and director of the Home Title Insurance Company.

MR. BENJAMIN F. WOODWARD, of Denver, Colo., died recently in Mexico. He was born in Newark, Ohio, June 25, 1834, and when 18 years of age was manager of the Pittsburg telepraph office of the Western Atlantic & Ohio Telegraph Company. He built the first telegraph line in Colorado, and for many years was manager for the Western Union Telegraph Company in Denver, and superintendent of the tele graph system for the Denver & Rio Grande Railway.

MR. WILLIAM ORMISTON CALLENDER, the founder of Callender's Cable & Construction Co., Ltd., died at his residence in Bournemouth, on March 14. Mr. Callender was born in Leith in 1827, and was consequently 81 years of age at the time of his death. He settled in London in 1866, and shortly thereafter became connected with the paving industry. In 1879 he patented an insulating material in which Trinidad bitumen formed the chief ingredient, and this material has become widely known as a dielectric for underground mains, under the name of "Vulcanized Bitumen." The Callenders Bitumen Telegraph and Waterproof Co., was founded in 1882, to develop this invention, and the present company, the Callender's Cable & Construction Company, Limited, is its successor. It will be remembered, also, that Mr. Callender organized an American company about 1884, but it had only a short-lived career.

STANISLAUS P. FRANCHOT, Senator of the Forty-seventh District of the State of New York, who established the National Electrolytic Company on the lands of the Niagara Falls Power Company at Niagara Falls, died following an operation in Montreal, Que., Tuesday, March 24. On the morning of Monday, March 16, the Senator suffered a fall at his home in Niagara Falls, and this resulted in a total paralysis of the lower portion of his body. Physicians who were called in to make a diagnosis of the case realized the paralysis was due to pressure on the spine, which might be relieved by an operation. For this reason he was taken to the Western Hospital in Montreal, where he was operated upon on the morning of Sunday, March 22. It was found that the spine was dislocated and fractured. The funeral was held from St. Peter's Church, Niagara Falls, Friday, March 27. It was attended by Governor Hughes, Lieutenant Governor Chanler, Speaker Wadsworth and over 100 Senators and Assemblymen, who traveled to Niagara in a special train to pay the final tribute to the dead Senator. The interment was private and in Riverdale Cemetery, Niagara Falls. Mr. Franchot was born in Morris, Otsego County, New York State. He graduated from Union College, Schenectady, in 1871, and in 1874 married Miss Eells, of West Virginia. In 1884 he went to Buckingham, Que., where he engaged in mining. In 1897 he came to Niagara Falls and established the National Electrolytic Company, of which he was vice-president at the time of his death. He was elected in 1906 to the State Senate as a Republican.

MR. WILLIAM A. KREIDLER, founder and principal proprietor of the *Western Electrician*, died of appoplexy in Augusta, Ga., March 26. Mr. Kreidler was born in South Dansville, N. Y., Aug. 20, 1858. He attended the University of Rochester, class of '84, and was a member of the D K E fraternity. In 1882, after two years in college, he removed to Chicago and entered the employment of the Western Electric Company, and shortly after became an advertising solicitor for the ELECTRICAL WORLD and manager of the Western office. In 1887 he founded the *Western Electrician*. As the paper prospered, Mr. Kreidler became also interested in outside non-electrical business ventures, with a large measure of success. He was one of the organizers of the old Chicago Electric Club and its secretary for several years. Of late years Mr. Kreidler had spent much of his time at his country house in Lake Bluff. His city home for many years was at the Belden, 295 Belden avenue. He was a member of the Union League Club, Exmoor Country Club and Lake Bluff Country Club, as well as of the American Institute of Electrical Engineers, the National Geographic Society and the Chicago Academy of Sciences. He was a pewholder in the Church of Our Saviour. Mr. Kreidler was not only a man of fine business ability, but he also possessed marked literary taste and was a collector of fine books. He was interested in the natural sciences, and he also possessed some skill as an inventor, and one or more patents have been taken out in his name. He was a kind-hearted man, of generous impulses, and his death is sincerely regretted by a large number of friends. Mr. Kreidler was married in 1893 to Miss Netta Ophelia Preston and his widow survives him. The other immediate members of his family are his mother, sister and two brothers, living in Olean, N. Y. The funeral took place on Monday, March 30, at 2:30 p. m. from the family residence in Lake Bluff.

Unclassified Items.

EXETER, N. H.—The Exeter, Hampton & Amesbury Street Railway Company, which was recently sold at auction has been reorganized. There will be two companies, one operating an electric lighting system, to be known as the Exeter & Hampton Electric Company, while the street railway will continue under the present name.

SEATTLE, WASH.—Contracts have been awarded by the Board of Public Works in connection with the cluster lamps which are to be placed on Third Avenue as follows: For conduits and underground work, to Meacham & Babcock, for $27,718; transformers and cables to Meacham & Babcock, for $10,070, and to F. T. Crowe & Company for ornamental poles, for $5,202.

FERGUS FALLS, MINN.—Bids will be received until April 15, by G. H. Gard, City Clerk, for furnishing material, including hydraulic and electrical machinery for the municipal electric light plant, and completing the abandoned contract of concrete dam and brick power house.

SPRINGFIELD, ILL.—The Illinois Inland Traction Company has been granted a charter with a capital stock of $100,000. The company proposes to build an electric railway from Chicago to Kankakee. The incorporators are: Carey W. Rhodes, Elmer Schlesinger, Edwin D. Lawlor, of Chocago; Edward Doepp, of Blue Ilsand, and H. C. Bangs, of Glencoe.

SONGO LOCK, ME.—Plans are being made by the Portland & Northern Railway Company to commence work on the construction of an electric railway to run from Portland to Bridgton.

HONOLULU, H. T.—At the annual meeting of the Honolulu Rapid Transit & Land Company the following named officers were elected: L. T. Peck, president; L. A. Thurston, first vice-president; J. B. Castle, second vice-president; William Williamson, secretary, and C. H. Atherton, treasurer.

WALDEN, N. Y.—Articles of incorporation have been filed with the secretary of state for the Wallkill River Company with a capital stock of $250,000 by A. J. Fowler, of Walden; C. B. Fuller, J. E. Fuller, Walter Greer, and G. B. Townsend, of New York, N. Y. The company proposes to construct a power plant on Wallkill River at Walden, and expects to develop about 2000 hp.

RUSTON, LA.—The citizens on March 25 voted to issue $50,000 in bonds, the proceeds of which to be used for extensions and improvements to the municipal electric light plant and water works system.

WILMINGTON, DEL.—The Board of Trustees of the County Hospital, at Farnhurst, is contemplating installing either an electric light plant or an acetylene gas plant, and has appointed a committee to investigate the cost of installing the same. The county is now paying more than $1,200 per year for lighting the hospital.

DENVER, COL.—The Nevada-California Power Company is preparing to make entensive improvements and extensions to its plants in Nevada, which will involve an expenditure of about $500,000. The company plans to enlarge its 7500-hp plant near Goldfield and double the output of the plant.

ELLWOOD CITY, PA.—The Ellwood City & Wurtemburg Electric Railway Company has been incorporated with a capital stock of $18,000 to build an electric railway in Lawrence County, three miles in length. The directors are: J. T. Macklin, Frisco, president; John M. Curry, S. P. Turner, J. N. Kirker, S. C. Van Gorder, and others.

SERGENT, KY.—The Letcher County Home Telephone Company is in the market for a complete telephone equipment for a telephone line from Vilas to Wright, via Tony.

STERLING, ILL.—The government is contemplating the installation of a complete telephone system, which is to extend the entire length of the Hennepin Canal. The central exchange will be located at Feeder Junction, near Sterling, and the lines are to be extended to the Illinois River and down the canal to the Mississippi River.

RICHMOND, IND.—Plans are being made by the Central Union Telephone Company for the construction of a new exchange building in this city.

PRENTICE, WIS.—The citizens have voted to appoint a committee to investigate the question of establishing a municipal water works system and electric light plant, and to secure information concerning the same and estimates of the cost of installing the plant and also the probable expense of operating the same. The streets are now lighted by oil lamps at a cost of nearly $1,600 per year.

BUTTE, MONT.—The stockholders of the Butte Electric & Power Company have approved the directors' proposition to issue $5,000,000, the proceeds to be applied to liquidating the floating debt of the company and its subsidiaries and providing them with additional working capital.

OGDEN, UTAH.—City Engineer Parker has filed with the state engineer two applications for water rights of the South Fork Canyon, a tributary of Ogden River. The first claim is for domestic purposes and the second to develop power for a municipal electric light and power plant; the water to be conducted through a 30-inch pipe line 40,000 feet in length to a point near the mouth of Ogden Canyon, where the proposed power plant will be located.

LOCKPORT, N. Y.—The International Power & Transmission Company, a subsidiary of the Niagara, Lockport & Ontario Power Company, has applied to the City Council for a franchise to furnish electricity in this city for lamps and motors. E. M. Ashley and P. F. King are among the directors.

NOME, ALASKA.—Plans are being made by the Nome Gold Dredging & Power Company for the construction of a hydro-electric plant on the Stewart River, near Nome, at a cost of about $70,000. The company has awarded a contract for a dredge, at a cost of $135,000, which will be electrically driven. George W. Darr, of New York, N. Y., is president.

Business Notes.

THE GORDON BATTERY COMPANY has secured buildings and land at Aldene-Roselle, N. J., where the offices and works of the company will be located on and after April 1, 1908.

THE G. & W. ELECTRIC SPECIALTY COMPANY, 128 West Jackson Boulevard, Chicago, is to furnish a large order of potheads for use in the rear of the switchboard of the Indiana Steel Company's great electrical plant at Gary, Ind. These are to be of the same type as installed by the Sanitary District of Chicago for its 6600 and 12,000-volt lines.

TAUSSIG & BABCOCK.—Messrs. William S. Taussig and Fred R. Babcock announce that they are now located at 1428 Marquette Building, Chicago, under the firm name of Taussig & Babcock. They are the exclusive agents in Chicago territory for the Burke Electric Company, of Erie, Pa.; Patten Manufacturing Company, Chattanooga, Tenn., and James Clark, Jr., Electric Company, Louisville, Ky.

ARC LIGHT EQUIPMENT FOR THE CITY OF CHICAGO.—The Central Electric Company, of Chicago, general Western agents for the Okonite products, is now delivering the first installations of arc-lighting equipment for the city of Chicago. This is one of the largest arc-lighting equipments that has been secured for some time, covering approximately 900 G. I. series alternating current lamps, 16 50-light oil-type arc-light regulators and approximately 800 kilowatts of transformers.

MR. JOSEPH A. SANDFORD, JR., formerly with C. S. Knowles, Boston, Mass., has taken a position as sales manager for the New Lexington High Voltage Porcelain Co., New Lexington, Ohio, manufacturer of porcelain insulators for high-voltage transmission lines. C. S. Knowles, who formerly had the exclusive agency for the above company, will now act as Eastern agent. Mr. Sandford will immediately make agency arrangements in this and other countries for the sale of the company's ware.

THE JACOBSON ENGINE COMPANY, Chester, Pa., has appointed as representatives Mr. F. D. McKercher, 1715 Prospect Avenue, Cleveland, Ohio; Mr. Theo. R. N. Gerdes, M. E., 5 Van Nest Place, New York City, and Mr. E. Kwartz, M. E., in Philadelphia, Pa. The company manufactures horizontal heavy-duty gas engines of the automatic type for producer gas, ranging in size from 20 hp to 500 hp. Business is reported so active that it has been necessary for this company to run 24 hours a day. Among some of the late shipments are two large producer engines for the Pacific Coast, and one large gas engine to operate on gasoline for Salt Lake City.

A NEW SINGLE-PHASE MOTOR.—The Mechanical Appliance Company, of Milwaukee, Wis., announces that it now has on the market a new line of series repulsion single-phase induction motors in sizes of from ⅛ hp up to 5 hp. These motors are self-starting, being started as series repulsion motors by means of a pair of short-circuited brushes bearing on a commutator. When up to speed, a short-circuiting, contact-making device short circuits the commutator segments so that the motor operates as an induction motor. This short-circuiting device acts automatically. The motor can be made to operate at three different speeds, and can also be made reversible. It is especially designed for the individual motor drive of various kinds of machinery.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City. Next meeting in September.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Annual meeting Albany, N. Y., April 30, May 1 and 2.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Atlantic City, N. J., June 29-July 2.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, Walter S. Mower, London, Ont.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Spring meeting, Detroit, Mich., June 23, 24, 25 and 26.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. Prescott Folwell, Room 512 Flatiron Building, New York. Next meeting at Atlantic City, N. J., October 13.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Assistant Secretary, S. E. Mumford, Detroit, Mich.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting at Toronto, June 10, 11 and 12.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Mulholland, Indianapolis, Ind.

CHICAGO ELECTRIC CLUB. Secretary, S. M. McFedries, care J. L. Schbreman & Co., Chicago.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting in October.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ware, Grand Rapids, Mich.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting at Savery Hotel, Des Moines, Ia., April 22 and 23.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting at Des Moines, Ia., April 23 and 24.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MINNESOTA CENTRAL STATION MEN'S ASSOCIATION. A. H. Lane, Glencoe, Minn., chairman.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo. Next meeting, Kansas City, May 6 and 7.

MISSOURI ELECTRIC LIGHT, GAS & STREET RAILWAY ASSOCIATION. Secretary, C. Z. Pierson, St. Charles, Mo. Next meeting at Marquette Hotel, St. Louis, April 23, 24 and 25.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York. Next meeting at Chicago, May 19, 20, 21 and 22, 1908.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting at Chicago, July 15.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting at Philadelphia, June 11.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, May 4 to 9.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Aug. 25, 26 and 27, 1908.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio. Next meeting at Columbus, May 15 and 16.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Galen Crow, Guthrie. Next meeting at Guthrie, May 25, 26 and 27.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting at El Paso, Tex., May 7, 8 and 9.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 24, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

882,553. BLOCK SIGNAL SYSTEM; Fred B. Corey, of Schenectady, N. Y. App. filed March 9, 1905. Block signal system of the type employing alternating currents and wherein the track rails are sectionally energized. Supplies a coil of a track relay from the secondary of the same transformer which supplies the track circuit of the block in advance.

882,554. SIGNAL; Fred B. Corey, of Schenectady, N. Y. App. filed Feb. 17, 1906. A signal system for single-track trolley roads. Makes use of direct-current magnets for shifting the signal and a locking magnet which prevents the signal from going to danger whenever the power circuit is interrupted.

882,564. ELECTRIC HEATER; Edward M. Hewlett, of Schenectady, N. Y. App. filed Aug. 3, 1907. Provides an electric atmospheric heater designed to be operated at a relatively low heat, and which can be brought up to its working temperature in a comparatively short time. Makes use of a sheet metal resistance element stamped in a special zigzag formation of circular outline.

882,569. RHEOSTAT; Charles D. Knight, of Schenectady, N. Y. App. filed July 18, 1907. Combined starting and speed regulating rheostat in which the motor is first brought up to running speed and the speed then varied within certain limits.

882,570. BURGLAR ALARM; Cosmo Liaci, of New Haven, Conn. App. filed June 6, 1907. A burglar alarm of the type having a spring-impelled circuit-closing element which is held in circuit-opening relation by a cord. Means are provided whereby the alarm is not operated except by unauthorized persons.

882,573. STORAGE BATTERY; William L. Merrin, Fredericktown, Ohio. App. filed Oct. 5, 1896. A storage battery comprising a container of corrugated sheet iron, an electrode shell therein of corrugated sheet iron, an electrolyte having no chemical effect on said container and electrode shell, and active material in said shell.

882,581. INDUCTION-MOTOR CONTROL; Karl A. Pauly, Schenectady, N. Y. App. filed March 9, 1906. The method of operating an induction motor at varying speeds which consists in establishing two sets of connections adapted to produce tendencies toward operation at two different limiting or synchronous speeds, supplying current to both sets of connections simultaneously, and varying the relative torques produced thereby.

882,582. PROCESS OF PRODUCING MANGANESE SILICID; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. The continuous process of producing manganese silicid, which consists in smelting a charge containing compounds of manganese and silicon and carbon, by means of an electrically heated resistance conductor, withdrawing the molten product from the furnace, and supplying the charge mixture as required, as set forth.

882,587. CABLE REEL; Edmond Rosenberg, of Paris, France. App. filed Aug. 16, 1907. An electric truck for use in coal mining. Has a reel rotatable on a vertical axis and having a sprocket connection with the traction wheels, so as to unwind a cable when the reel is proceeding in passages which do not have a trolley connection.

882,602. CONTROLLING SWITCH; Harold E. White, of Schenectady, N. Y. App. filed Sept. 18, 1906. Controlling switch employing blow-out magnets particularly applicable to motor controllers. Provides individual blow-out coils for each of the fingers and specially arranged insulating means to effectively insulate adjacent blow-out coils from one another.

882,606. INDUCTION MOTOR CONTROL; E. F. W. Alexanderson, Schenectady, N. Y. App. filed March 7, 1906. The method of controlling an induction motor having both primary and secondary members adapted for connection for different pole numbers, which consists in supplying current to both sets of primary connections simultaneously and varying the relative impedances of the circuits formed by the two sets of secondary connections.

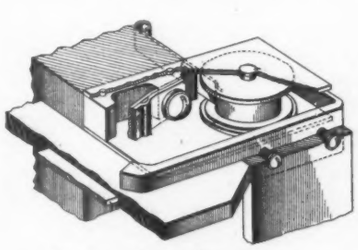
882,607. MAGNETIC CLUTCH; Robert Anderson, of Schenectady, N. Y. App. filed Sept. 18, 1906. Magnetic clutch completely enclosed in a drum-shaped casing and having two driven elements spring-impelled apart and capable of being attracted together by an intermediate iron-clad magnet.

882,609. BONDING-PIN; Frederick H. Ayer, of Chicago Heights, Ill. App. filed Feb. 23, 1907. Bonding-pin having a V-shaped groove on one side, the faces of which are arc-shaped, so as to co-operate with a symmetrical bonding wire having similar arcuate faces throughout.

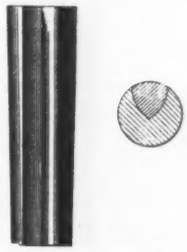
882,610. ADJUSTABLE ELECTRICAL RESISTANCE; Frederick O. Ball, of Plainfield, N. J. App. filed Nov. 21, 1907. Makes use of a series of U-shaped resistance elements which are engaged in series between clamping devices. The loops are longitudinally adjustable so as to vary the resistance.

882,639. CONTROLLING SYSTEM FOR ELECTRIC MOTORS; Henry D. James, of Pittsburg, Pa. App. filed April 3, 1905. Provides means for preventing a reversing switch from being moved from either of its closed circuit positions to its off position while the counter electromotive force generated by the motor exceeds a predetermined amount.

882,658. CONTROL SYSTEM FOR ELECTRIC MOTORS; Hermon L. Van Valkenburg, of Pittsburg, Pa. App. filed Sept. 2, 1904. System of control for electrical apparatus in which the voltage applied to a translating device is varied by adjusting the circuit connections to a subdivided transformer winding. Also combines a set of voltage varying switches and a set of resistance-governing switches so that they shall operate in the proper sequence and shall be prevented from operating in any other sequence or order.



882,602.—Controlling Switch.



882,609.—Bonding Pin.

882,673. LIGHTNING ARRESTER; Walter T. Goddard, of Victor, N. Y. App. filed Aug. 7, 1905. A form of lightning arrester having a spark gap for the passage of lightning, and a magnet to widen the spark gap, so as to interrupt an arc thereacross after the lightning has passed.

882,681. ELECTROMAGNETIC TOY ENGINE; Harry G. Kawekotte and Henry W. Klausmann, of Indianapolis, Ind. App. filed Dec. 18, 1907. A U-shaped electromagnet, has depending poles which embrace a wheel having iron pins or armatures at spaced points thereon, and which is rotated by an intermittent energization of the magnet.

882,682. COMMUTATOR FOR POLYPHASE CURRENTS; Alexander Heyland, Brussels, Belgium. App. filed Jan. 21, 1903. The combination with a commutator, of brushes bearing thereon, means for causing relative movement of the commutator and brushes, circuits connected to a portion of the segments of the commutator and resistances connecting said circuits to said brushes, when the latter are bearing on segments not connected to said circuits, and intermittently connecting the segments with which said circuits are connected.

882,684. SOUND-MUFFLER; John F. Hirsh et al., St. Louis, Mo. App. filed Aug. 5, 1907. A device of the character described, comprising an inner and outer shell of semispherical shape, a layer of felt interposed between said shells and extending slightly beyond the edge thereof, and a flange on the inner shell for clamping said felt in position, substantially as described.

882,687. ELECTRICAL CONTROL SYSTEM; Henry D. James, of Pittsburg Pa. App. filed April 3, 1905. Means for preventing closing of the circuit breaker when the reversing switch is thrown from its forward to its reverse position, or vice versa, unless the counter electromotive force generated by the motor is less than a predetermined amount.

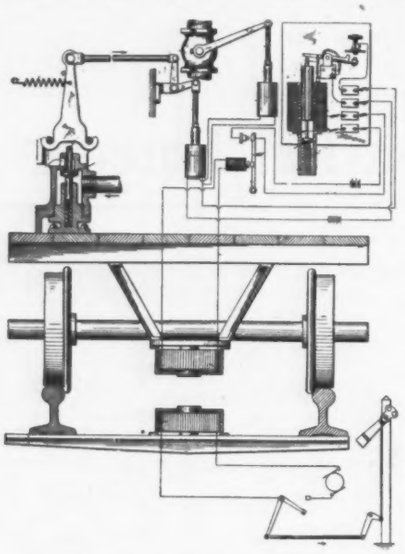
882,691. TORREFYING APPARATUS FOR THE TEXTILE INDUSTRY; Charles F. Kaisser, Lille, France. App. filed Nov. 26, 1906. In an apparatus of the character described, the combination with a body of refractory material having an interior cavity, and a slot in one face, of a heating device arranged within the said cavity.

882,695. SYSTEM FOR AUTOMATICALLY STOPPING CARS OR TRAINS; Edward E. Kleinschmidt, of New York, N. Y. App. filed Feb. 8, 1906. Has an electromagnet placed between the rails in proximity to a signal and a coil supported preferably from the under side of a car so as to be carried in proximity to the track magnet. The track magnet is controlled by a signal mechanism so as to be energized when the signal is at danger.

882,717. COMBINED TROLLEY WHEEL AND SLEET CUTTER; Edmund M. Schollenberger, of Chicago, Ill. App. filed Oct. 30, 1907. A trolley wheel having a cylindrical core and cup-shaped flanges which are hollowed out to fit over the end of the core and be removable therefrom when desired.

882,733. ELECTRIC FURNACE; Edwin Appleby, of Chicago, Ill. App. filed March 26, 1906. The furnace has a removable bottom portion and a pair of carbon-electrodes which can be manipulated to cause an arc within the furnace, by separate depending hand levers.

882,744. SIGNALING DEVICE; Spencer C. Cart, of Spokane, Wash. App. filed April 6, 1907. Details of construction of a signal including an electric bell and an incandescent light which are operated under danger conditions.



882,695.—System for Automatically Stopping Cars or Trains.

882,752. LETTER BOX ALARM AND INDICATOR; Oscar F. Erickson, of Berkeley, and Richard H. Bradshaw, of Oakland, Cal. Circuit-closing device for rural delivery mail boxes, having an electric bell which rings in a predetermined way when mail is deposited in the box.

882,758. FIRE-ALARM SYSTEM; Henry H. Hillier, of Pasadena, Cal. App. filed April 13, 1907. In place of special fire-alarm boxes at points along the street, the patentee makes use of a device used in conjunction with a telephone and which works on messenger-call principle with a specially constructed receiving annunciator.

882,788. ELECTRIC FURNACE; Albert L. Marsh, of Lake Bluff, Ill. App. filed Sept. 19, 1907. A cup-shaped furnace in which the inner lining of the furnace is made in separate rings or sections through which the current flows from top to bottom and which have sufficient resistance longitudinally to become highly heated.

882,803. INSULATOR; Leonard W. Storror, of San Francisco, Cal. App. filed Jan. 2, 1906. Two-part insulator having a zigzag, annular space between the separate portions through which leakage currents are obliged to pass.

882,833. TROLLEY HARP; Frank M. Mudler, of Pittsburg, Pa. App. filed Dec. 5, 1907. The trolley wheel is journaled on a fixed axle which has a transverse duct leading from an oil supply well in the trolley harp.

882,848. SNAP SWITCH; Wm. M. Scott and James H. Wyatt, of Philadelphia, Pa. App. filed Sept. 10, 1907. Two-button snap switch having a number of sheet metal parts which are organized to give a spring-impelled movement to the switch element.

882,872. SYSTEM OF ELECTRICAL DISTRIBUTION; R. N. Chamberlain, Depew, N. Y. App. filed Jan. 17, 1906. System of distribution making use of a storage battery with a booster normally in series therewith, the two being connected in parallel with the main generating apparatus of the system or of a substation.

882,892. ELECTRICAL PROTECTIVE APPARATUS; J. A. Kenny, Chicago, Ill. App. filed Jan. 7, 1904. A double-throw knifeblade switch making use of fuse wires embodied in knifeblade switch elements. Has spaced carbon clocks of special construction to serve as a lightning arrester.

882,958. PROCESS FOR MANUFACTURING NITRIC ACID BY MEANS OF SUPERHEATING, ETC.; H. Pauling, Brandau, Austria-Hungary. App. filed Aug. 12, 1902. Consists in heating a gas mixture containing nitrogen and oxygen to the oxidation-point of nitrogen, cooling said mixture and storing the heat, and transferring the stored heat to a fresh mixture. Makes use of an electric furnace.

882,966. TROLLEY; H. C. Reynolds, Portersville, Cal. App. filed Aug. 24, 1907. The trolley harp is pivoted to the trolley pole so as to swing into an inclined or horizontal position in passing curves and overhead switches.

882,979. STRAIN INSULATOR; W. C. Terry, Boston, Mass. App. filed Feb. 14, 1907. A bar of insulating material, preferably wood, has metallic heads at each end with special clamping devices which engage and bind a bight in the wire.

882,990. RESISTANCE UNIT; L. E. Parringer, Schenectady, N. Y. App. filed Sept. 30, 1907. A resistance unit or member particularly for lightning arresters and comprising alundum, graphite and fire clay.

883,003. AUDIPHONE; O. J. Davy, Washington, D. C. App. filed May 3, 1907. An audiphone comprising a flat yoke, discus pieces secured directly to the ends of said yoke, funnel-shaped ear pieces having their larger ends closed by said discus pieces, a diaphragm in each ear piece, and means for electrically vibrating said diaphragm.

883,007. ALTERNATING CURRENT REGULATOR; A. R. Everest, Rugby, England. App. filed July 13, 1906. Constant current transformer having a secondary winding which is delicately balanced to be movable through a considerable vertical range of movement. Has a specially formed core designed to diminish the changing leakage ratios.

883,008. THERMOSTAT; C. J. Fox, London, Eng. App. filed Jan. 28, 1907. Thermostat element consists of a sheet metal strip which sags downward to establish an alarm circuit in case a predetermined temperature is exceeded.

883,013. VIBRATOR; A. G. Gray, St. John, New Brunswick, Can. App. filed Sept. 4, 1907. A medical vibrator having a longitudinal body member with a bell magnet device at one end.

883,026. SIGNALING ON RAILWAYS; C. M. Jacobs et al., Reading, Eng. App. filed Aug. 9, 1907. Makes use of inclined cam shoes along the track which move circuit closing levers to establish alarm circuits in the locomotive cab under certain conditions.

883,029. ENGINE STOP; V. J. King, Lorain, Ohio. App. filed May 3, 1907. The throttle wheel has a weight impelled drum which can be tripped to revolve and close the throttle by an electromagnet.

883,030. VAPOR ELECTRIC APPARATUS; O. O. Kruh, Schenectady, N. Y. App. filed Sept. 15, 1905. Renewed Jan. 31, 1908. A vapor electric apparatus comprising an exhausted envelop having a plurality of anodes and a cathode, and a tubular member confining the discharge from the cathode.

883,036. APPARATUS FOR PRODUCING A GASEOUS MIXTURE HAVING DISINFECTING AND EXTINGUISHING PROPERTIES; Rene Marot, Paris, France. App. filed July 7, 1904. Has a reservoir adapted to contain liquid sulfur dioxid. Makes use of a fan motor for impelling an air current through the apparatus whereby certain disinfecting gases are produced.

883,043. DYNAMO-ELECTRIC MACHINE; John P. Nikonow, Pittsburg, Pa. App. filed April 13, 1907. A dynamo electric machine comprising a plurality of poles each formed of a series of cores constituting parts of distinct magnetic circuits, the cores being arranged to cause the magnetic circuits to flow from the far side of one pole to the adjacent side of the next pole.

883,059. ELECTRICALLY OPERATED SWITCH; H. F. Starrett, Milwaukee, Wis. App. filed Feb. 7, 1902. Switch in which the movable element is adapted to be controlled by a solenoid. Includes copper brushes and carbon contacts which make the final break.

883,062. STRAIN RELIEVING ATTACHMENT FOR TELEGRAPH KEYS; W. H. Teachworth, Waxahachie, Texas. App. filed June 1, 1906. An attachment for telegraph keys comprising a vibratory arm, a releasing member therefor, a contact adapted to be engaged by said arm, a shiftable key member, and an adjustable connection between the key member and said releasing member for operating the latter when the key member is shifted.

883,078. CONTROLLER FOR ELECTRIC MOTORS; T. E. Barnum, Milwaukee, Wis. App. filed March 2, 1904. Renewed Feb. 21, 1906 A controller for electric motors whereby the direction in which the motor is run may be controlled and the motor automatically stopped a predetermined number of times throughout its range of operation.

883,088. TELEPHONE INSTRUMENT; Clifford E. Cole, Birmingham, Ala. App. filed Jan. 10, 1906. A telephone receiver having a slide acting as a valve to cut off the sound.

883,093. DIVIDED-CENTRAL TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed June 15, 1903. Details of cord and exchange signal circuits.

883,110. ELECTRIC FURNACE; H. L. Hartenstein, Constantine, Mich. App. filed Nov. 30, 1906. An electric furnace having a metallic frame from which there projects downwardly a pair of convergent electrodes which may be made to dip into a cup-shaped crucible which is rolled beneath said frame.

883,114. VAPOR ELECTRIC APPARATUS; O. O. Kruh, Schenectady, N. Y. App. filed Oct. 18, 1905. The combination of a receptacle or container, electrodes therein, and shields therefor arranged one inside of the other.

883,139. CYCLIC PROCESS OF RECOVERING METALLIC TIN; Franz von Kugelgen et al., Holcombs Rock, Va. App. filed June 10, 1907. The cyclic process of receovering metallic tin from tin-bearing materials, which consists in treating a charge of the material with an anhydrous selective solvent of tin and producing a tin compound, decomposing said compound into metallic tin and an acid radical, and employing said acid radical to treat another charge of material.

883,140. PROCESS OF ELECTROLYZING AQUEOUS SOLUTIONS OF STANNIC CHLORID, Franz von Kugelgen et al., Holcombs Rock, Va. App. filed June 10, 1907. The process of electrolyzing aqueous solutions of stannic chlorid, which consists in conducting the electrolysis in a diaphragm cell and combining the stannic hydrozid and hydrochloric acid present in the anolyte and catholyte, respectively.

883,141. PROCESS OF ELECTROLYZING AQUEOUS STANNIC CHLORID SOLUTIONS; Franz von Kugelgen et al., Holcombs Rock, Va. App. filed June 10, 1907. Relates to modifications of the above.

12,765. Reissue. PLURAL LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. Reissue of 721,774. Cluster lamp socket making use of a sheet metal frame with a transversely extending insulating diaphragm which supports the center contacts and the threaded shells of the lamps.

12,766. Reissue. PLURAL LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. Reissue of 721,777. Relates to modifications of the above.